

# Lummi Intertidal Baseline Inventory

## **Appendix D: Shorebird and Marine Mammal Survey**

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March 2010



Some of the bird species that were counted during the LIBI Shorebird and Marine Mammal Survey

- A. Great Blue Heron (*Ardea herodias*)
- B. Bald Eagle (*Haliaeetus leucocephalus*)
- C. Glaucous-Winged Gull (*Larus glaucescens*)
- D. American Widgeon (*Anas americana*)

(Photos courtesy of the US Fish and Wildlife Service National Digital Library)

## **Executive Summary**

The Shorebird and Marine Mammal Survey documented the presence, distribution, and timing of these species on the Lummi Reservation tidelands. A monthly visual census of shorebirds and marine mammals over a period of 11 months at 12 sites was conducted. Unlike previous bird surveys conducted by the North Cascades Audubon Society and Western Washington University, all bird species that were observed during the survey were recorded and observations were made during all seasons.

In total, 52 bird species and 2 marine mammal species were identified from October 2008 to September 2009. Bird abundance was higher in winter than in summer. Particularly large numbers of ducks (thousands) and geese (hundreds) were present in Lummi Bay during the fall and winter months.

# Table of Contents

<b>Executive Summary .....</b>	<b>i</b>
<b>Table of Contents .....</b>	<b>ii</b>
<b>1.0 Introduction.....</b>	<b>1</b>
<b>2.0 Methods.....</b>	<b>1</b>
<b>3.0 Results .....</b>	<b>4</b>
3.1 General Trends.....	4
3.2 Temporal Trends.....	4
3.3 Spatial Patterns.....	9
3.4.1 Bald Eagles ( <i>Haliaeetus leucocephalus</i> ) .....	16
3.4.2 Other Raptors (Order Falconiformes).....	18
3.4.3 Geese (Subfamily Anserinae) .....	20
3.4.4 Dabbling Ducks (Subfamily Anatinae).....	22
3.4.5 Diving Ducks (Subfamily Aythyinae) .....	24
3.4.6 Seaducks (Subfamily Merginae).....	26
3.4.7 Grebes (Family Podicipedidae).....	28
3.4.8 Great Blue Herons ( <i>Ardea herodias</i> ) .....	30
3.4.9 Alcids (Family Alcidae).....	32
3.4.10 Plovers (Family Scolopacidae) .....	34
3.4.11 Caspian Terns ( <i>Sterna caspia</i> ).....	36
3.4.12 Gulls (Family Laridae).....	38
3.4.13 Pinnipeds (Superfamily Pinnipedia) .....	40
<b>4.0 Discussion.....</b>	<b>42</b>
<b>5.0 References.....</b>	<b>44</b>

## 1.0 Introduction

The objective of the Lummi Intertidal Baseline Inventory (LIBI) was to document the natural resources on the Lummi Reservation tidelands, including the diversity and abundance of birds and marine mammals.

Birds have an important ceremonial and subsistence role in the life of the Lummi people and are also an important component in the wider ecosystem. Ceremonially important species include the bald eagle, golden eagle, and red-tailed hawk. They are culturally important for their feathers and bones. Other species are hunted for subsistence, with various ducks (e.g., Mallards) and Brant Geese being the most obvious of these. Ducks and other shorebirds also play an important role in the ecology of the tidelands through their feeding activities and nutrient cycling.

The North Cascades Audubon Society (NCAS) and Western Washington University (WWU) had previously conducted wintertime bird surveys at several sites around the Reservation. However, there was no systematic approach to enumerating shore birds during the spring, summer, and fall seasons on the Lummi Reservation. In addition, previous surveys only focused on a subset of the birds utilizing the Lummi tidelands: the NCAS survey focused on shore birds only and WWU's survey focused on marine birds only.

Marine mammals have also historically held cultural significance for Lummi and other Coast Salish tribes. They play a role in the ecology of the tidelands and affect fishermen directly. Sea Lions and Harbor Seals haul out on Reservation tidelands and could be adversely impacted by an oil spill.

The purpose of the LIBI Shorebird and Marine Mammal Survey was to count all bird and marine mammal species that use the Lummi Reservation tidelands and waterways across all four seasons. To achieve consistency with existing data, we adopted the same suite of shore sites that have previously been used in wintertime surveys but added some additional sites to improve the geographic resolution of the survey.

## 2.0 Methods

Lummi Natural Resources Department staff, with the aid of volunteers, performed monthly bird surveys at 12 sites on the Reservation (Figure D.1). Volunteers that participated in the LIBI census were screened for previous bird census experience to ensure high data quality. Shore-based counts were generally conducted at the same locations where previous surveys have been conducted. In addition, two extra sites were added to include the Lummi Reservation side of Bellingham Bay and the southern part of Lummi Bay.



**Figure D.1.** Location of Shorebird and Marine Mammal Survey Sites

Birds and Marine Mammals were identified and counted using a standard fixed-radius count methodology (Bibby *et al.* 2000). The survey crew drove to the sites and then walked out on to the shore where the counts were conducted. The point count began when the surveyors reached the specified location, and included any birds that had taken flight with the arrival of the surveyors. There were two surveyors present for each point

count. Usually one person would count and call out numbers and species while the other person recorded. At sites where there was no large raft of birds noticeable to the naked eye, the site area was divided in two and each person counted half of the area. During the summer months this approach was used much more frequently to ensure efficiency when bird abundances were low.

Lummi Natural Resources Department staff and volunteers used 16-50x binoculars from Oct 2008 to Oct 2009, and 20-40x scopes from Oct 2008 to Jan 2009, which were borrowed from Western Washington University to conduct the survey. During the later part of 2009, the scopes became unavailable and the binoculars were used instead. All birds within a 360-degree area of each point were counted. Standard guides for identification were on hand to review bird identification (Sibley 2003). For rafts of birds, a sub-sample of the raft was enumerated and multiplied over the entire raft (Bibby *et al.* 2000).

Bird census information is highly dependent on visibility. Accordingly, site visits were scheduled to occur at times when weather conditions generally provided the optimum visibility. Weather conditions were documented at every site visit, and marine visibility was assessed with the Beaufort scale (Table D.1). These methods follow standard census methods performed by previous surveys (North Cascades Audubon Society 2008). However, due to time constraints and scheduling difficulties, there were some occasions when visibility conditions were not ideal.

**Table D.1.** Beaufort Scale Definitions Used to Assess Marine Visibility

Beaufort Number	Description	Sea Conditions	Land Conditions
0	Calm	Flat.	Calm. Smoke rises vertically.
1	Light air	Ripples without crests.	Wind motion visible in smoke.
2	Light breeze	Small wavelets. Crests of glassy appearance, not breaking.	Wind felt on exposed skin. Leaves rustle.
3	Gentle breeze	Large wavelets. Crests begin to break; scattered whitecaps.	Leaves and smaller twigs in constant motion.
4	Moderate breeze	Small waves with breaking crests. Fairly frequent white horses.	Dust and loose paper raised. Small branches begin to move.
5	Fresh breeze	Moderate waves of some length. Many white horses. Small amounts of spray.	Branches of a moderate size move. Small trees begin to sway.

Thirteen maps were developed to show seasonal patterns of shorebird and marine mammal presence across the Reservation. They were created for the bald eagle (*Haliaeetus leucocephalus*), raptors (order Falconiformes, excluding bald eagles), geese (subfamily Anserinae), dabbling ducks (subfamily Anatinae), diving ducks (subfamily Aythyinae), grebes (family Podicipedidae), scoters (*Melanitta* species), great blue herons (*Ardea herodias*), alcids (family Alcidae), plovers, Caspian terns (*Sterna caspia*), gulls (family Laridae), and pinnipeds (superfamily Pinnipedia). These species or groups were chosen because of their cultural and ecological importance.

## **3.0 Results**

### **3.1 General Trends**

During the 11-month survey period a total of 52 different bird species and 2 marine mammal species were identified.

### **3.2 Temporal Trends**

Table D.2 shows the average count and standard error over all sites for each taxon and for each month surveyed.

Generally, the diversity of birds present across the Reservation tidelands was lowest in the summer months and highest during the fall and winter months (Figure D.2). Likewise, the total abundance of birds was lowest during the summer and highest during the fall and winter (Figure D.3)



**Table D.2.** Temporal Patterns in Bird and Marine Mammal Counts across Lummi Reservation Tidelands

Taxa	10/9/08	11/13/08	12/4/08	1/21/09	2/20/09	3/6/09	4/2/09	5/15/09	6/4/09	7/16/09	9/4/09
Alcids: Alcid species* (Family Alcidae)	0 (0)	0 (0)	0.08 (0.08)	0.17 (0.17)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Alcids: Marbled Murrelet ( <i>Brachyramphus marmoratus</i> )	0 (0)	0 (0)	0.08 (0.08)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.08 (0.08)
Alcids: Pigeon Guillemot ( <i>Cephus columba</i> )	0.08 (0.08)	0 (0)	1.92 (1.25)	0.25 (0.25)	0.17 (0.17)	0 (0)	0.33 (0.23)	0 (0)	1.5 (0.95)	0.92 (0.64)	0.33 (0.23)
Buntings and Sparrows: Snow Bunting ( <i>Plectrophenax nivalis</i> )	0 (0)	0 (0)	0 (0)	0.17 (0.17)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Cormorants: Cormorant species* (Family Phalacrocoracidae)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	4.5 (4.15)	0 (0)	0 (0)	0 (0)	0 (0)
Cormorants: Double-Crested Cormorant ( <i>Phalacrocorax auritus</i> )	11.92 (6.94)	15.5 (9.33)	18.67 (8.46)	4.17 (2.85)	5.92 (2.82)	4.25 (2.46)	17.08 (16.63)	3.42 (3.33)	5 (5)	0.08 (0.08)	0.33 (0.23)
Cormorants: Pelagic Cormorant ( <i>Phalacrocorax pelagicus</i> )	0.42 (0.29)	0 (0)	0.92 (0.45)	0.17 (0.17)	0.33 (0.26)	0.25 (0.18)	0.08 (0.08)	0 (0)	0.17 (0.17)	0 (0)	0 (0)
Corvids: American Crow ( <i>Corvus brachyrhynchos</i> )	0 (0)	0.08 (0.08)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1.17 (0.53)	0.33 (0.19)	0.33 (0.33)	0 (0)
Ducks: American Widgeon ( <i>Anas americana</i> )	55 (55)	2.75 (2.75)	151.5 (99.75)	115.75 (48.13)	107.5 (37.52)	87.25 (47.64)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ducks: Barrow's Goldeneye ( <i>Bucephala islandica</i> )	0.17 (0.17)	0 (0)	0.08 (0.08)	2.08 (1.59)	2.42 (1.38)	0.75 (0.44)	1.17 (0.6)	0 (0)	0 (0)	0 (0)	0 (0)
Ducks: Black Scoter ( <i>Melanitta nigra</i> )	11.25 (11.25)	2.08 (2.08)	0 (0)	0 (0)	0 (0)	3.75 (2.55)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ducks: Bufflehead ( <i>Bucephala albeola</i> )	0 (0)	12.5 (6.37)	9.17 (2.45)	11.83 (2.65)	10.75 (2.61)	10.08 (2.93)	5.42 (1.67)	1.75 (1.58)	0 (0)	0 (0)	0 (0)
Ducks: Common Goldeneye ( <i>Bucephala clangula</i> )	0 (0)	0.33 (0.33)	5.08 (2.13)	4.83 (2.92)	2.08 (2.08)	1.67 (1.28)	5.67 (3.68)	0.42 (0.33)	0 (0)	0 (0)	0 (0)
Ducks: Common Merganser ( <i>Mergus merganser</i> )	0 (0)	0 (0)	0 (0)	0.25 (0.18)	0.25 (0.18)	0.08 (0.08)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ducks: Dabbling Duck species* (Subfamily Anatinae)	0 (0)	0 (0)	50 (33.49)	271 (154.29)	72.92 (49.95)	0 (0)	21.25 (16.88)	20.83 (20.83)	0 (0)	0 (0)	0 (0)
Ducks: Diving Duck species* (Subfamily Aythyinae)	0 (0)	0 (0)	6.17 (2.46)	0 (0)	1 (1)	0 (0)	6 (4.08)	8 (5.77)	0.67 (0.58)	0 (0)	0 (0)
Ducks: Duck species* (Family Anatidae)	41.67 (41.67)	12.5 (8.34)	1.25 (0.85)	39.83 (39.56)	16.67 (16.67)	0 (0)	40.08 (29.72)	0 (0)	16.67 (16.67)	0 (0)	0 (0)

**Table D.2.** Temporal Patterns in Bird and Marine Mammal Counts across Lummi Reservation Tidelands, cont'd

Taxa	10/9/08	11/13/08	12/4/08	1/21/09	2/20/09	3/6/09	4/2/09	5/15/09	6/4/09	7/16/09	9/4/09
Ducks: Eurasian Widgeon ( <i>Anas penelope</i> )	0 (0)	0 (0)	0 (0)	0.25 (0.25)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ducks: Gadwall ( <i>Anas strepera</i> )	4.17 (4.17)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.58 (0.58)	0 (0)	0 (0)	0 (0)	0 (0)
Ducks: Goldeneye species* ( <i>Bucephala</i> species)	0 (0)	0 (0)	0 (0)	0 (0)	2.5 (2.5)	0 (0)	16.67 (16.67)	0 (0)	0 (0)	0 (0)	0 (0)
Ducks: Greater Scaup ( <i>Aythya marila</i> )	12.58 (12.58)	67.58 (61.37)	24.17 (19.55)	76.92 (42.9)	51.17 (27.25)	10.75 (7.54)	0 (0)	0.33 (0.23)	0 (0)	0 (0)	0 (0)
Ducks: Green-Wing Teal ( <i>Anas carolinensis</i> )	7.83 (7.48)	0 (0)	19.67 (19.67)	0 (0)	0 (0)	6.33 (4.97)	3.33 (3.33)	0 (0)	0 (0)	0 (0)	0 (0)
Ducks: Harlequin Duck ( <i>Histrionicus histrionicus</i> )	0.5 (0.5)	0.17 (0.17)	0.25 (0.25)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ducks: Hooded Merganser ( <i>Lophodytes cucullatus</i> )	0 (0)	0 (0)	0 (0)	0.25 (0.25)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ducks: Longtailed Duck ( <i>Clangula hyemalis</i> )	0 (0)	0.25 (0.25)	1 (0.59)	7.17 (4.7)	5.33 (3.11)	12.25 (6.6)	0.42 (0.42)	0 (0)	0 (0)	0 (0)	0 (0)
Ducks: Mallard ( <i>Anas platyrhynchos</i> )	0 (0)	129.5 (91.59)	30.67 (29.94)	35 (15.19)	58.33 (24.12)	47.92 (25.01)	0.67 (0.51)	0 (0)	0.25 (0.25)	0 (0)	0.17 (0.17)
Ducks: Merganser species* (Subfamily Merginae)	0 (0)	0 (0)	0 (0)	0.58 (0.58)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ducks: Northern Pintail ( <i>Anas acuta</i> )	0.5 (0.5)	82.42 (81.15)	441.08 (426.79)	68.25 (29.91)	83.67 (31.81)	38.17 (16.11)	0.5 (0.5)	0 (0)	0 (0)	0 (0)	0 (0)
Ducks: Red-Breasted Merganser ( <i>Mergus serrator</i> )	0 (0)	0.75 (0.44)	15.42 (12.53)	1.42 (0.45)	0.83 (0.27)	0.25 (0.18)	0.33 (0.19)	0 (0)	0 (0)	0 (0)	0 (0)
Ducks: Scoter species* ( <i>Melanitta</i> species)	25 (25)	0.33 (0.33)	0.42 (0.42)	0 (0)	0 (0)	0 (0)	16.67 (16.67)	0 (0)	0 (0)	0 (0)	0 (0)
Ducks: Surf Scoter ( <i>Melanitta perspicillata</i> )	19.58 (8.62)	27.17 (17.03)	23.58 (18.76)	6.42 (2.74)	16.42 (5.89)	70.58 (39.18)	6.5 (2.31)	7.33 (4.45)	0.17 (0.17)	0 (0)	0 (0)
Ducks: White-Winged Scoter ( <i>Melanitta fusca</i> )	20.92 (7.14)	8.08 (5.38)	1.67 (1.23)	17.58 (7.57)	6.83 (4.47)	12.17 (8.78)	0 (0)	1.42 (0.81)	0.25 (0.25)	0 (0)	0 (0)
Geese: Brant ( <i>Branta bernicla</i> )	41.75 (41.66)	102.58 (51)	28.92 (15.68)	3.75 (3.75)	0 (0)	3.5 (3.5)	92.25 (63.34)	1.5 (1.41)	0 (0)	0 (0)	0 (0)
Geese: Canada Goose ( <i>Branta canadensis</i> )	2.5 (2.5)	6.33 (4.09)	3.17 (3.17)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

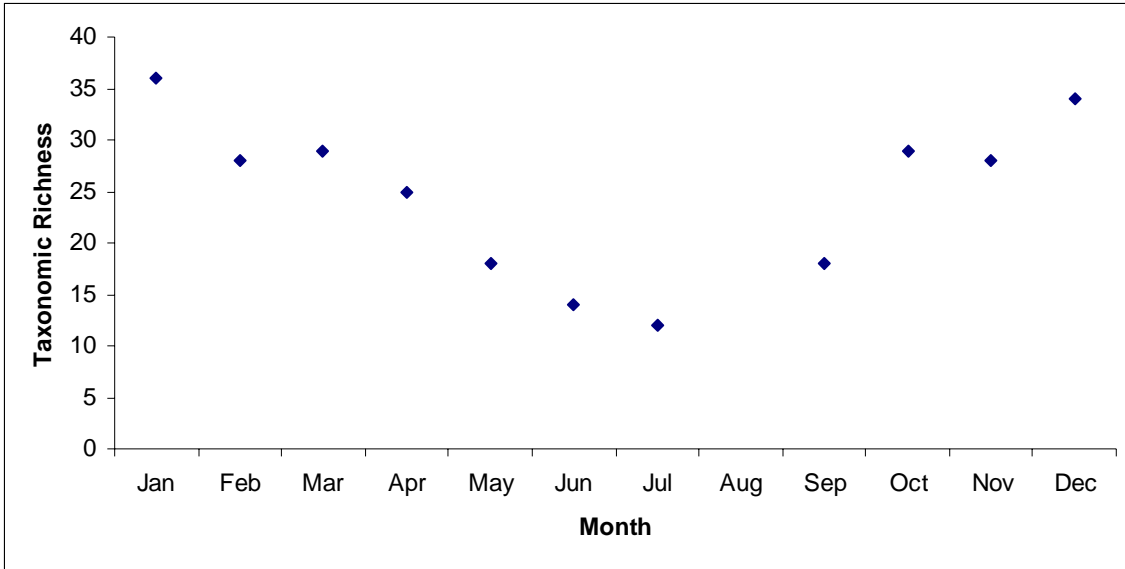
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Taxa	10/9/08	11/13/08	12/4/08	1/21/09	2/20/09	3/6/09	4/2/09	5/15/09	6/4/09	7/16/09	9/4/09
Grebes: Horned Grebe ( <i>Podiceps auritus</i> )	2.33 (0.73)	1.17 (0.42)	1.5 (0.54)	2.42 (1.13)	2.33 (1.11)	1.08 (0.53)	0.25 (0.13)	0 (0)	0 (0)	0 (0)	0.33 (0.19)
Grebes: Red-Necked Grebe ( <i>Podiceps grisegena</i> )	0 (0)	0.83 (0.83)	0.83 (0.66)	0.17 (0.17)	0.67 (0.51)	0.17 (0.11)	0.58 (0.36)	0 (0)	0 (0)	0 (0)	0 (0)
Grebes: Western Grebe ( <i>Aechmophorus occidentalis</i> )	4.42 (3.46)	2.67 (1.64)	0.58 (0.44)	0.17 (0.17)	0.42 (0.33)	0.92 (0.33)	0.08 (0.08)	0 (0)	0 (0)	0 (0)	0.42 (0.19)
Gulls: Bonaparte's Gull ( <i>Larus philadelphia</i> )	2.25 (1.69)	0 (0)	0 (0)	0.67 (0.58)	0.5 (0.42)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.5 (0.26)
Gulls: California Gull ( <i>Larus californicus</i> )	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1.25 (0.86)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gulls: Glaucous-Winged Gull ( <i>Larus glaucescens</i> )	50.67 (17.66)	23.33 (5.73)	21.67 (7.08)	13.17 (3.64)	10.75 (2.22)	7.25 (1.88)	36.92 (9.92)	12 (4.57)	6.92 (2.06)	14.58 (7.64)	8.83 (1.61)
Gulls: Gull species* (Family Laridae)	3.75 (3.75)	3.83 (3.83)	2.5 (1.69)	7.25 (4.82)	5.25 (3.83)	0 (0)	0 (0)	0.5 (0.5)	14.25 (6.89)	20.25 (16.85)	0 (0)
Gulls: Herring Gull ( <i>Larus argentatus</i> )	0 (0)	0 (0)	0 (0)	0.08 (0.08)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.17 (0.17)
Gulls: Mew Gull ( <i>Larus canus</i> )	13.58 (7.21)	0 (0)	0.08 (0.08)	0.25 (0.18)	0.42 (0.29)	0.5 (0.26)	1.08 (1.08)	0 (0)	0 (0)	0 (0)	0.42 (0.23)
Gulls: Ring-Billed Gull ( <i>Larus delawarensis</i> )	1 (1)	0.58 (0.58)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.25 (0.25)	0.33 (0.33)	26 (17.13)	1.33 (0.62)
Hérons: Great Blue Heron ( <i>Ardea herodias</i> )	1.33 (0.66)	0.25 (0.25)	0.5 (0.5)	0.42 (0.26)	0.5 (0.34)	0.08 (0.08)	5.08 (2.63)	5.25 (2.71)	2.08 (0.7)	5 (2.14)	0.58 (0.29)
Kingfishers: Belted Kingfisher ( <i>Ceryle alcyon</i> )	0.08 (0.08)	0 (0)	0.17 (0.11)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.17 (0.17)	0.08 (0.08)	0.17 (0.11)
Kingfishers: Kingfisher species* (Family Alcedinidae)	0.08 (0.08)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Loons: Common Loon ( <i>Gavia immer</i> )	2.25 (1.37)	0.42 (0.23)	1.67 (0.67)	0.08 (0.08)	0.25 (0.18)	0.25 (0.18)	0.17 (0.11)	0.33 (0.19)	0 (0)	0.17 (0.17)	0 (0)
Loons: Pacific Loon ( <i>Gavia pacifica</i> )	0.08 (0.08)	0.08 (0.08)	0 (0)	0.17 (0.17)	0.08 (0.08)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Loons: Red-Throated Loon ( <i>Gavia stellata</i> )	0.08 (0.08)	0.08 (0.08)	0.08 (0.08)	0 (0)	0 (0)	0 (0)	0.33 (0.19)	0 (0)	0 (0)	0 (0)	0 (0)
Owls: Long-Eared Owl ( <i>Asio otus</i> )	0 (0)	0 (0)	0 (0)	0.33 (0.33)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

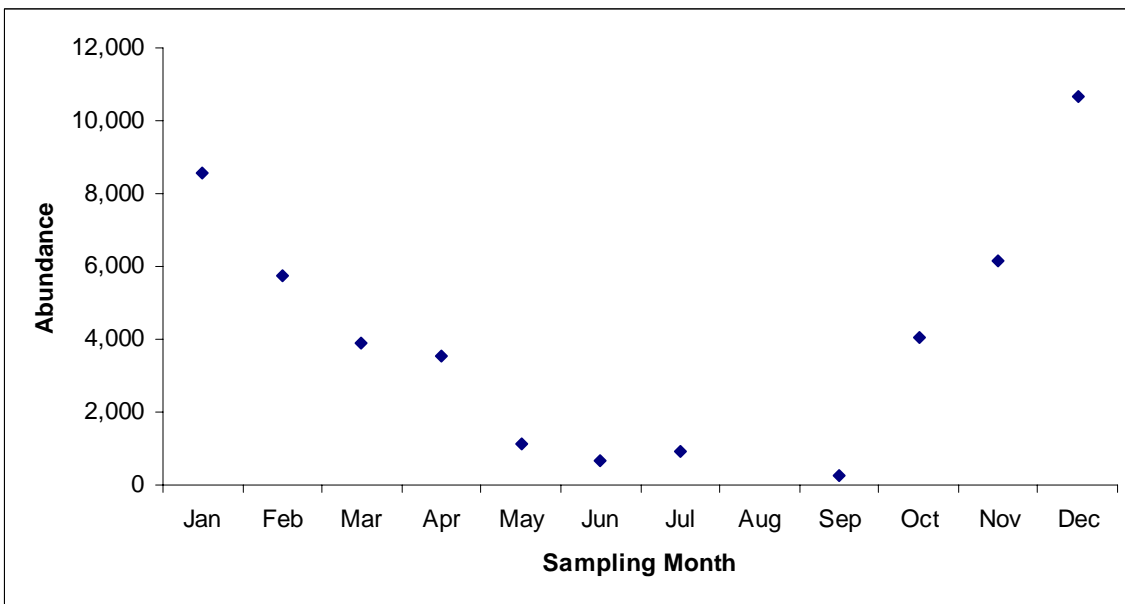
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Taxa	10/9/08	11/13/08	12/4/08	1/21/09	2/20/09	3/6/09	4/2/09	5/15/09	6/4/09	7/16/09	9/4/09
Pinnipeds: Harbor Seal ( <i>Phoca vitulina</i> )	0.08 (0.08)	0 (0)	0.17 (0.11)	0 (0)	0 (0)	0 (0)	1.42 (1.33)	2.33 (2.33)	0 (0)	3.42 (3.33)	0.08 (0.08)
Pinnipeds: Sea Lion ( <i>Zalophus californianus</i> )	0.08 (0.08)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Plovers: Black Turnstone ( <i>Arenaria melanocephala</i> )	0 (0)	0 (0)	1.25 (1.25)	0.58 (0.44)	0 (0)	3.33 (3.33)	8.92 (5.57)	0 (0)	0 (0)	0 (0)	0 (0)
Plovers: Dunlin ( <i>Calidris alpina</i> )	0 (0)	10 (5.47)	16.42 (14.9)	17.92 (9.95)	9.25 (6.24)	0 (0)	0.83 (0.83)	1.67 (1.67)	0 (0)	3 (3)	6.33 (3.51)
Plovers: Killdeer ( <i>Charadrius vociferus</i> )	0.5 (0.36)	0 (0)	0.08 (0.08)	0.08 (0.08)	0 (0)	0.08 (0.08)	0 (0)	0.17 (0.11)	0 (0)	0.17 (0.11)	0.08 (0.08)
Plovers: Sandpiper species* (Family Scolopacidae)	0 (0)	0 (0)	6.25 (6.25)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.75 (0.75)	0 (0)	0 (0)
Plovers: Western Sandpiper ( <i>Calidris mauri</i> )	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.17 (0.17)
Raptors: Bald Eagle ( <i>Haliaeetus leucocephalus</i> )	0.25 (0.18)	0.25 (0.18)	0.08 (0.08)	1.08 (0.38)	0.17 (0.11)	0.17 (0.11)	0.25 (0.18)	1.58 (0.69)	1 (0.46)	0.17 (0.11)	0.58 (0.23)
Raptors: Northern Harrier ( <i>Circus cyaneus</i> )	0.08 (0.08)	0.08 (0.08)	0.17 (0.11)	0.08 (0.08)	0.17 (0.17)	0.08 (0.08)	0 (0)	0 (0)	0 (0)	0 (0)	0.08 (0.08)
Raptors: Peregrin Falcon ( <i>Falco peregrinus</i> )	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.08 (0.08)	0 (0)	0 (0)	0 (0)
Raptors: Redtailed Hawk ( <i>Buteo jamaicensis</i> )	0 (0)	0 (0)	0.08 (0.08)	0.08 (0.08)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Swallows: Barn Swallow ( <i>Hirundo rustica</i> )	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.92 (0.51)	0 (0)	0 (0)	0 (0)
Swallows: Cliff Swallow ( <i>Petrochelidon pyrrhonota</i> )	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.42 (0.42)	0 (0)	0 (0)
Swallows: Swallow species* (Family Hirundinidae)	0.08 (0.08)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Terns: Caspian Tern ( <i>Sterna caspia</i> )	0 (0)	0 (0)	0 (0)	0 (0)	1.58 (1.58)	0 (0)	0 (0)	22 (12.45)	5.08 (3.58)	2.25 (1.67)	0 (0)

\* Counts for these rows only include individuals that could not be identified more precisely in the field.



**Figure D.2.** Taxonomic Richness of Birds, by Month



**Figure D.3.** Relative Abundance of Birds, by Month

### 3.3 Spatial Patterns

Table D.3 shows the average count and standard error over time for each taxon by site. Generally, the number of species documented during the survey (Figure D.4) was lowest in Bellingham Bay along Lummi Shore Road (24 species) and in Portage Bay (27 species), higher in Hale Passage and at Neptune Beach (35 species), and highest in Lummi Bay (47 species).

**Table D.3. Spatial Patterns in Bird and Marine Mammal Counts across Lummi Reservation Tidelands**

Taxa	B'ham Bay	Hale Passage			Lummi Bay					Neptune Beach		Portage Bay
	Lummi Shore Road	Portage Spit	Gooseberry Point	Stommish Grounds	Lummi Flats	Middle Dike	North Dike	Onion Bay	South Dike	Neptune	Sandy Point	Portage Bay
Alcids: Alcid species* (Family Alcidae)	0 (0)	0 (0)	0.09 (0.09)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.18 (0.18)	0 (0)
Alcids: Marbled Murrelet ( <i>Brachyramphus marmoratus</i> )	0 (0)	0 (0)	0.18 (0.12)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Alcids: Pigeon Guillemot ( <i>Cephus columba</i> )	0 (0)	0.18 (0.18)	2.91 (1.19)	1.36 (0.86)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1.55 (1.01)	0 (0)
Buntings and Sparrows: Snow Bunting ( <i>Plectrophenax nivalis</i> )	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.18 (0.18)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Cormorants: Cormorant species* Family Phalacrocoracidae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.36 (0.36)	0 (0)	0 (0)	0 (0)	0 (0)	4.55 (4.55)
Cormorants: Double-Crested Cormorant ( <i>Phalacrocorax</i> )	16.27 (11.11)	9.09 (4.23)	1.82 (0.57)	1.09 (0.44)	0.09 (0.09)	21.18 (10.35)	7 (3.39)	0 (0)	0.09 (0.09)	0.64 (0.43)	3.91 (1.08)	33 (17.77)
Cormorants: Pelagic Cormorant ( <i>Phalacrocorax pelagicus</i> )	0.09 (0.09)	0 (0)	0.45 (0.36)	0.18 (0.18)	0 (0)	0.27 (0.27)	0 (0)	0 (0)	0 (0)	1.09 (0.44)	0.45 (0.25)	0 (0)
Corvids: American Crow ( <i>Corvus brachyrhynchos</i> )	0.27 (0.2)	0.45 (0.46)	0.18 (0.18)	0.36 (0.28)	0 (0)	0 (0)	0 (0)	0 (0)	0.45 (0.36)	0 (0)	0 (0)	0.36 (0.36)
Ducks: American Widgeon ( <i>Anas americana</i> )	7.45 (5.07)	0 (0)	2.27 (2.27)	3.45 (2.35)	159.36 (107.26)	13.73 (7.99)	126.09 (60.43)	100.82 (53.17)	118.45 (62.27)	1.09 (1.09)	0 (0)	34.27 (22.41)
Ducks: Barrow's Goldeneye ( <i>Bucephala islandica</i> )	0.55 (0.28)	0.55 (0.46)	0.09 (0.09)	0.27 (0.27)	0.09 (0.09)	2.91 (1.99)	0.27 (0.2)	0 (0)	0 (0)	0 (0)	0.64 (0.64)	1.91 (1.12)
Ducks: Black Scoter ( <i>Melanitta nigra</i> )	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	16.36 (12.18)	2.27 (2.27)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ducks: Bufflehead ( <i>Bucephala albeola</i> )	8.27 (6.17)	5.09 (2.39)	2.82 (1.36)	11.18 (3.59)	5.73 (3.11)	10.91 (3.63)	5 (2.61)	1.91 (1.72)	9.09 (3.21)	0.64 (0.36)	1.64 (0.72)	4.82 (2.01)
Ducks: Common Goldeneye ( <i>Bucephala clangula</i> )	3.45 (2.3)	10.91 (5.04)	0.82 (0.72)	0.27 (0.2)	0.55 (0.46)	0.64 (0.39)	0.55 (0.39)	0 (0)	0.36 (0.36)	0.18 (0.18)	1 (0.68)	3.18 (1.51)
Ducks: Common Merganser ( <i>Mergus merganser</i> )	0 (0)	0.36 (0.24)	0 (0)	0 (0)	0 (0)	0 (0)	0.09 (0.09)	0 (0)	0 (0)	0 (0)	0.18 (0.12)	0 (0)
Ducks: Dabbling Duck species* (Subfamily Anatinae)	0.27 (0.27)	0 (0)	0 (0)	0 (0)	115.91 (113.43)	43.18 (34.39)	22.73 (15.62)	30.36 (24.96)	221.82 (142.43)	0 (0)	0 (0)	41.36 (27.59)
Ducks: Diving Duck species* (Subfamily Aythyinae)	2.45 (2.45)	0.45 (0.36)	5.82 (3.68)	1.45 (1.45)	1.09 (1.09)	0 (0)	0 (0)	0 (0)	0.82 (0.82)	4.55 (2.95)	0.64 (0.64)	6.55 (6.35)
Ducks: Duck species* (Family Anatidae)	2.45 (1.87)	0.73 (0.73)	0 (0)	0 (0)	9.09 (9.09)	125 (59.07)	0.27 (0.27)	0 (0)	0.45 (0.46)	2.27 (2.27)	12.73 (12.73)	31 (31)

**Table D.3. Spatial Patterns in Bird and Marine Mammal Counts across Lummi Reservation Tidelands, cont'd**

Taxa	B'ham Bay	Hale Passage			Lummi Bay				Neptune Beach		Portage Bay	
	Lummi Shore Road	Portage Spit	Gooseberry Point	Stommish Grounds	Lummi Flats	Middle Dike	North Dike	Onion Bay	South Dike	Neptune	Sandy Point	Portage Bay
Ducks: Eurasian Widgeon ( <i>Anas penelope</i> )	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.27 (0.27)	0 (0)	0 (0)	0 (0)	0 (0)
Ducks: Gadwall ( <i>Anas strepera</i> )	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.64 (0.64)	4.55 (4.55)	0 (0)	0 (0)	0 (0)	0 (0)
Ducks: Goldeneye species* ( <i>Bucephala</i> species)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2.73 (2.73)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	18.18 (18.18)
Ducks: Greater Scaup ( <i>Aythya marila</i> )	6.73 (4.61)	11.36 (6.38)	0.91 (0.73)	7.91 (5.23)	25.09 (12.03)	77.91 (66.66)	103.09 (55.77)	0 (0)	11.18 (9.05)	0 (0)	3.64 (2.05)	17.82 (13.5)
Ducks: Green-Wing Teal ( <i>Anas carolinensis</i> )	0 (0)	0 (0)	0 (0)	0 (0)	5.45 (5.45)	0 (0)	4.64 (3.67)	22.27 (21.38)	8.18 (8.18)	0 (0)	0 (0)	0 (0)
Ducks: Harlequin Duck ( <i>Histrionicus histrionicus</i> )	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.18 (0.18)	0 (0)	0 (0)	0 (0)	0.82 (0.58)	0 (0)
Ducks: Hooded Merganser ( <i>Lophodytes cucullatus</i> )	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.27 (0.27)	0 (0)	0 (0)	0 (0)
Ducks: Longtailed Duck ( <i>Clangula hyemalis</i> )	0.09 (0.09)	8.64 (5.74)	3.36 (1.45)	0 (0)	5 (5)	5.91 (5.91)	0 (0)	1.36 (1.36)	0 (0)	0.82 (0.55)	0.73 (0.38)	2.91 (1.83)
Ducks: Mallard ( <i>Anas platyrhynchos</i> )	1.64 (1.64)	5.09 (2.89)	1.82 (1.82)	1.82 (1.13)	110.18 (46.21)	15.45 (8.3)	115.18 (97.56)	12.73 (11.31)	58.09 (26.78)	0.45 (0.31)	0 (0)	7.55 (6.77)
Ducks: Merganser species* (Subfamily Merginae)	0 (0)	0 (0)	0 (0)	0 (0)	0.64 (0.64)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ducks: Northern Pintail ( <i>Anas acuta</i> )	2.09 (1.48)	20.55 (12.4)	1.36 (1.36)	3.55 (2.4)	597.45 (462.1)	13.45 (9.13)	21.82 (16.02)	61.55 (29.4)	53.09 (33.13)	0 (0)	0 (0)	4.64 (2.47)
Ducks: Red-Breasted Merganser ( <i>Mergus serrator</i> )	0.91 (0.62)	0.45 (0.31)	0.45 (0.25)	0.27 (0.2)	0.18 (0.18)	0.36 (0.36)	14.27 (13.78)	0 (0)	0.45 (0.28)	0.82 (0.48)	0.64 (0.39)	1.91 (1.81)
Ducks: Scoter species* ( <i>Melanitta</i> species)	0.36 (0.36)	0 (0)	0 (0)	0 (0)	0 (0)	27.27 (27.27)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	18.64 (18.14)
Ducks: Surf Scoter ( <i>Melanitta perspicillata</i> )	9.45 (3.93)	23.91 (9.47)	10.09 (3.96)	20.91 (8.2)	19.36 (18.57)	5.73 (5.43)	49.09 (41.34)	0 (0)	0 (0)	2.82 (1.5)	3.18 (2.08)	49.36 (25.06)
Ducks: White-Winged Scoter ( <i>Melanitta fusca</i> )	3.73 (3.17)	18.73 (7.88)	4 (3.07)	6 (5.16)	0 (0)	11.82 (7.96)	14.27 (9.1)	0 (0)	0 (0)	0.18 (0.18)	3.45 (2.71)	13 (6.19)
Geese: Brant ( <i>Branta bernicla</i> )	6.82 (5.49)	0 (0)	0.09 (0.09)	0 (0)	58.36 (45.99)	150 (74.36)	70.09 (43.57)	3.82 (3.82)	0 (0)	0 (0)	5.82 (3.26)	4.18 (4.08)
Geese: Canada Goose ( <i>Branta canadensis</i> )	0 (0)	0 (0)	0 (0)	0 (0)	2.09 (2.09)	0 (0)	0 (0)	6.91 (4.76)	0 (0)	0 (0)	0.64 (0.64)	3.45 (3.46)

**Table D.3. Spatial Patterns in Bird and Marine Mammal Counts across Lummi Reservation Tidelands, cont'd**

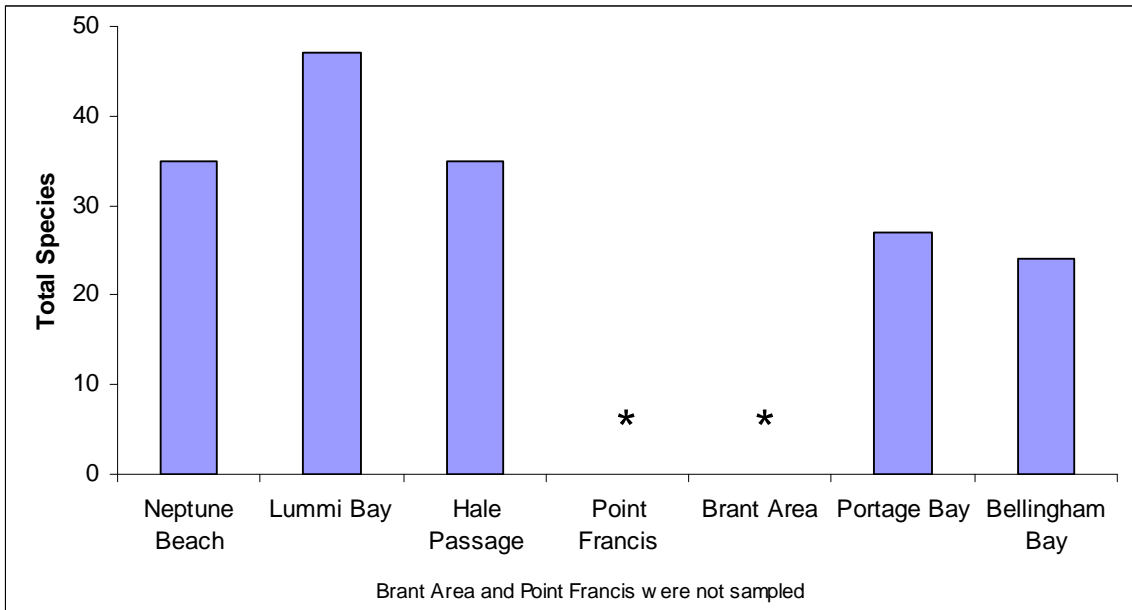
Taxa	B'ham Bay	Hale Passage			Lummi Bay				Neptune Beach		Portage Bay	
	Lummi Shore Road	Portage Spit	Gooseberry Point	Stommish Grounds	Lummi Flats	Middle Dike	North Dike	Onion Bay	South Dike	Neptune	Sandy Point	Portage Bay
Grebes: Horned Grebe ( <i>Podiceps auritus</i> )	1.27 (0.66)	3 (1.47)	1.45 (0.58)	1.36 (0.56)	0.36 (0.28)	0.18 (0.12)	0.09 (0.09)	0 (0)	0.36 (0.24)	1.27 (0.51)	1.64 (0.71)	1.45 (0.84)
Grebes: Red-Necked Grebe ( <i>Podiceps grisegena</i> )	0 (0)	0 (0)	1.64 (0.84)	0.27 (0.2)	0.91 (0.91)	0 (0)	0 (0)	0 (0)	0 (0)	0.45 (0.36)	0.27 (0.2)	0 (0)
Grebes: Western Grebe ( <i>Aechmophorus occidentalis</i> )	0.82 (0.38)	1.91 (1.52)	1.82 (1.1)	0.45 (0.46)	0 (0)	0 (0)	0.55 (0.55)	0 (0)	0 (0)	0.45 (0.25)	4.09 (3.8)	0.45 (0.25)
Gulls: Bonaparte's Gull ( <i>Larus philadelphia</i> )	0 (0)	0.91 (0.55)	0 (0)	0 (0)	0.18 (0.18)	1.09 (0.74)	0 (0)	0 (0)	0 (0)	0.09 (0.09)	2 (1.81)	0 (0)
Gulls: California Gull ( <i>Larus californicus</i> )	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.55 (0.55)	0.82 (0.82)	0 (0)	0 (0)	0 (0)	0 (0)
Gulls: Glaucous-Winged Gull ( <i>Larus glaucescens</i> )	7.27 (1.07)	28.09 (7.22)	10.45 (2.16)	13 (3.26)	16.55 (4.34)	13.18 (4.47)	27.82 (10.66)	37.36 (11.66)	13.09 (5.91)	29.73 (19.66)	14.55 (4.5)	13.73 (5.74)
Gulls: Gull species* (Family Laridae)	0.55 (0.55)	3.64 (3.64)	0.09 (0.09)	4.73 (4.08)	9.55 (6.3)	2.73 (1.95)	1.09 (0.74)	5.64 (4.26)	0.91 (0.62)	11.91 (7.19)	0 (0)	22 (18.36)
Gulls: Herring Gull ( <i>Larus argentatus</i> )	0 (0)	0.18 (0.18)	0 (0)	0 (0)	0.09 (0.09)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gulls: Mew Gull ( <i>Larus canus</i> )	0.45 (0.46)	2.45 (1.78)	0.73 (0.33)	0.09 (0.09)	0 (0)	1.18 (1.18)	0.45 (0.46)	6.36 (6.36)	0.18 (0.18)	0.27 (0.2)	5.55 (5.54)	0.09 (0.09)
Gulls: Ring-Billed Gull ( <i>Larus delawarensis</i> )	0 (0)	8.45 (6.75)	0.45 (0.36)	0 (0)	0.36 (0.36)	0.18 (0.18)	0 (0)	18.82 (18.13)	0.36 (0.36)	0 (0)	3.18 (3.18)	0.36 (0.28)
Hérons: Great Blue Heron ( <i>Ardea herodias</i> )	0.55 (0.39)	3.64 (3.07)	1.82 (1.82)	1.55 (1.28)	4.73 (1.93)	2 (1.27)	2 (1.08)	1.55 (0.77)	4.36 (2.17)	0 (0)	0.18 (0.12)	0.64 (0.54)
Kingfishers: Belted Kingfisher ( <i>Ceryle alcyon</i> )	0 (0)	0.18 (0.18)	0 (0)	0 (0)	0 (0)	0 (0)	0.09 (0.09)	0.09 (0.09)	0.09 (0.09)	0 (0)	0.09 (0.09)	0.18 (0.12)
Kingfishers: Kingfisher species* (Family Alcedinidae)	0 (0)	0 (0)	0 (0)	0 (0)	0.09 (0.09)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Loons: Common Loon ( <i>Gavia immer</i> )	2.27 (1.51)	0.18 (0.12)	0.45 (0.28)	0.36 (0.24)	0.09 (0.09)	0.18 (0.18)	0 (0)	0 (0)	0 (0)	1.09 (0.59)	0.45 (0.25)	1 (0.47)
Loons: Pacific Loon ( <i>Gavia pacifica</i> )	0 (0)	0 (0)	0 (0)	0.27 (0.2)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.18 (0.12)	0 (0)
Loons: Red-Throated Loon ( <i>Gavia stellata</i> )	0 (0)	0.18 (0.12)	0.18 (0.12)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.18 (0.18)	0 (0)	0.09 (0.09)



**Table D.3. Spatial Patterns in Bird and Marine Mammal Counts across Lummi Reservation Tidelands, cont'd**

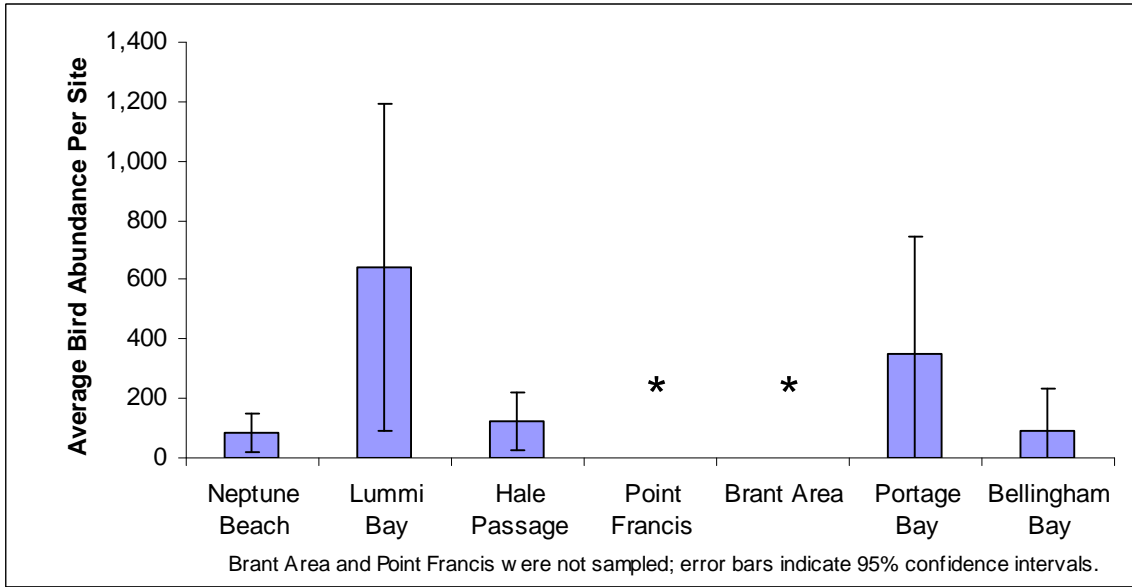
Taxa	B'ham Bay	Hale Passage			Lummi Bay				Neptune Beach		Portage Bay	
	Lummi Shore Road	Portage Spit	Gooseberry Point	Stommish Grounds	Lummi Flats	Middle Dike	North Dike	Onion Bay	South Dike	Neptune	Sandy Point	Portage Bay
Owls: Long-Eared Owl ( <i>Asio otus</i> )	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.36 (0.36)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Pinnipeds: Harbor Seal ( <i>Phoca vitulina</i> )	0.09 (0.09)	0.09 (0.09)	0.18 (0.12)	0.09 (0.09)	0 (0)	0 (0)	0 (0)	0 (0)	0.09 (0.09)	0 (0)	0 (0)	7.64 (4.26)
Pinnipeds: Sea Lion ( <i>Zalophus californianus</i> )	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.09 (0.09)	0 (0)	0 (0)
Plovers: Black Turnstone ( <i>Arenaria melanocephala</i> )	0 (0)	0 (0)	0.45 (0.46)	0 (0)	0 (0)	8.18 (5.53)	4.55 (4.55)	0 (0)	0 (0)	0 (0)	2.18 (1.43)	0 (0)
Plovers: Dunlin ( <i>Calidris alpina</i> )	4.55 (4.55)	0 (0)	0 (0)	0 (0)	6.36 (4.48)	23.18 (9.94)	3.73 (2.06)	2.55 (2.02)	11.36 (7.69)	3.27 (3.27)	16.36 (16.36)	0 (0)
Plovers: Killdeer ( <i>Charadrius vociferus</i> )	0 (0)	0.09 (0.09)	0.09 (0.09)	0.09 (0.09)	0 (0)	0.09 (0.09)	0 (0)	0.36 (0.36)	0.27 (0.2)	0 (0)	0.27 (0.14)	0 (0)
Plovers: Sandpiper species* (Family Scolopacidae)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.18 (0.18)	0 (0)	0 (0)	0 (0)	0 (0)
Plovers: Western Sandpiper ( <i>Calidris mauri</i> )	0.82 (0.46)	0.36 (0.2)	0.09 (0.09)	0.36 (0.2)	0.55 (0.31)	0.91 (0.58)	0.36 (0.2)	0 (0)	1.18 (0.57)	0.09 (0.09)	0 (0)	1.36 (0.39)
Raptors: Bald Eagle ( <i>Haliaeetus leucocephalus</i> )	0 (0)	0 (0)	0 (0)	0 (0)	0.64 (0.2)	0 (0)	0 (0)	0.09 (0.09)	0.09 (0.09)	0 (0)	0 (0)	0 (0)
Raptors: Northern Harrier ( <i>Circus cyaneus</i> )	0.09 (0.09)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Raptors: Peregrin Falcon ( <i>Falco peregrinus</i> )	0 (0)	0 (0)	0 (0)	0 (0)	0.09 (0.09)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.09 (0.09)
Raptors: Redtailed Hawk ( <i>Buteo jamaicensis</i> )	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.45 (0.46)	0.18 (0.18)	0.36 (0.36)	0 (0)	0 (0)
Swallows: Barn Swallow ( <i>Hirundo rustica</i> )	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.45 (0.46)	0 (0)	0 (0)	0 (0)
Swallows: Cliff Swallow ( <i>Petrochelidon pyrrhonota</i> )	0 (0)	16.82 (12.83)	0.09 (0.09)	0 (0)	3.91 (3.91)	0.45 (0.28)	0.09 (0.09)	9.91 (6.38)	1.73 (1.73)	0 (0)	0.09 (0.09)	0.64 (0.64)
Swallows: Swallow species* (Family Hirundinidae)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.36 (0.36)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Terns: Caspian Tern ( <i>Sterna caspia</i> )	0.09 (0.09)	0.09 (0.09)	0.18 (0.12)	0.09 (0.09)	0 (0)	0 (0)	0 (0)	0 (0)	0.09 (0.09)	0 (0)	0 (0)	7.64 (4.26)

\*Counts for these rows only include individuals that could not be identified more precisely in the field.



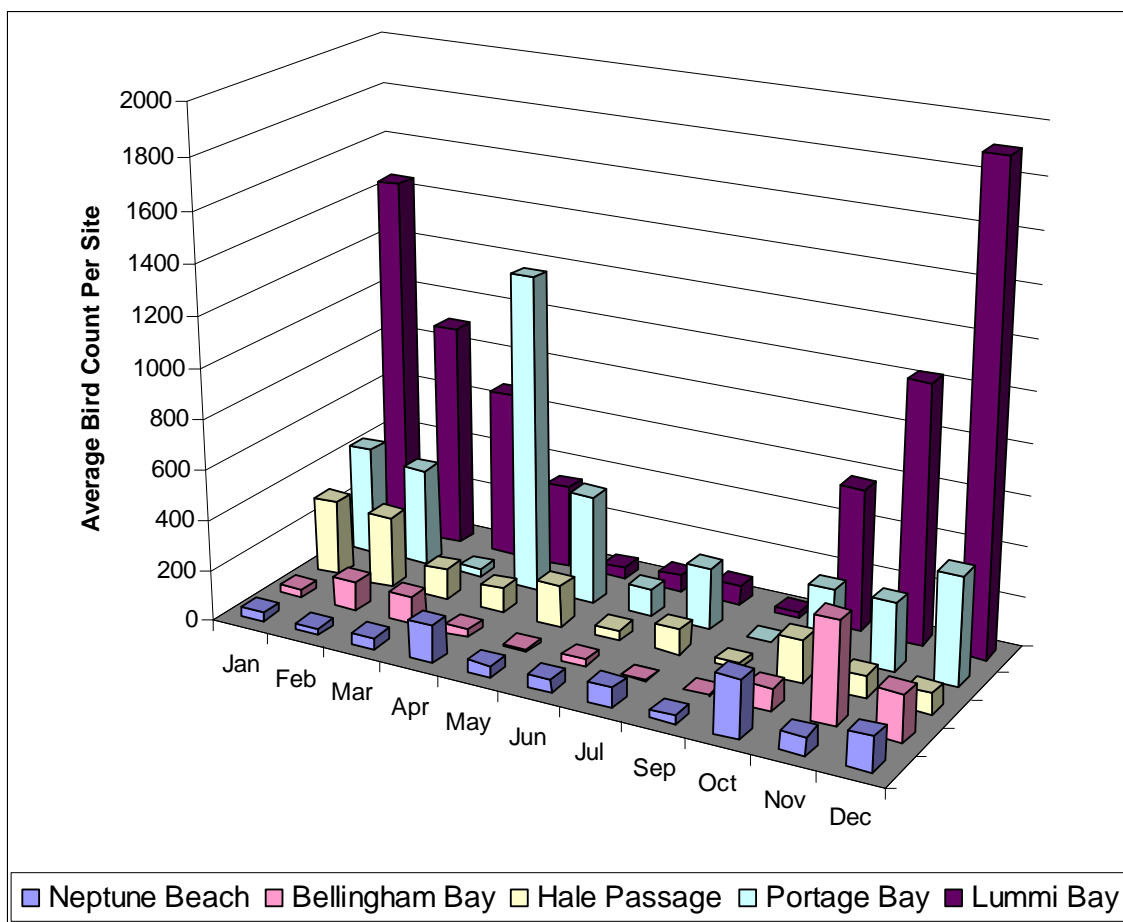
**Figure D.4. Taxonomic Richness of Birds by Area**

As shown in Figure D.5, the number of birds counted at each site was generally highest at Lummi Bay (n = 5 sites) and Portage Bay (n = 1 site), and lowest at Neptune Beach (n = 2 sites), Hale Passage (n = 3 sites), and Bellingham Bay (n = 1 site).



**Figure D.5. Relative Abundance of Birds by Area**

Figure D.6 shows the average number of birds counted per site by area and by month. This indicates that the seasonal pattern of high wintertime abundance and low summertime abundance shown in Figure D.3 appears to be driven by the relatively high numbers of birds present in Lummi Bay, Portage Bay, and (to a lesser extent) Hale Passage during the fall and winter.



**Figure D.6.** Comparison of Average Bird Abundance Per site, by Month and Area

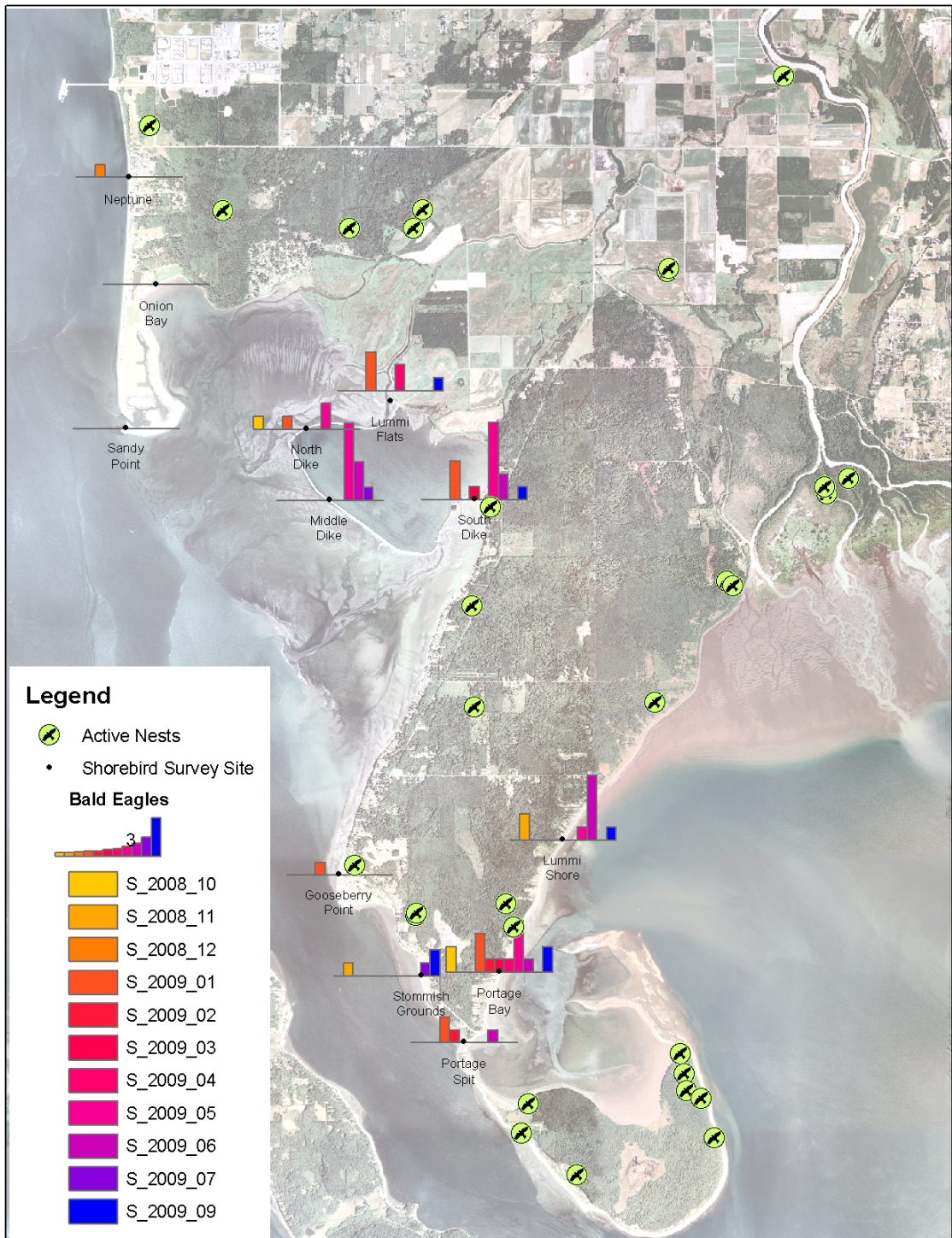
A chi-square goodness of fit analysis of the results indicated that average bird counts were significantly different depending on month ( $p < 0.05$ ) and area ( $p < 0.05$ ). A chi-square test of independence indicated that the average bird counts depended on both the month and the area ( $p < 0.05$ ). For example, although there is a clear seasonal trend for high wintertime abundance in Lummi Bay and Portage Bay, this trend was not apparent at Neptune Beach.

### **3.4 Species of Interest**

#### **3.4.1 Bald Eagles (*Haliaeetus leucocephalus*)**

Bald eagles (*Haliaeetus leucocephalus*) were treated separately from other raptors due to their particular cultural and ecological importance. Figure D.7 shows the monthly counts of Bald Eagles for each of the sites visited during the LIBI survey. Generally, bald eagles were most commonly encountered in Lummi Bay, Portage Bay, and adjacent to Lummi Shore Road, but were seldom found along Neptune Beach/Sandy Point. Abundance of bald eagles was generally highest during the spring and summer months at most sites.

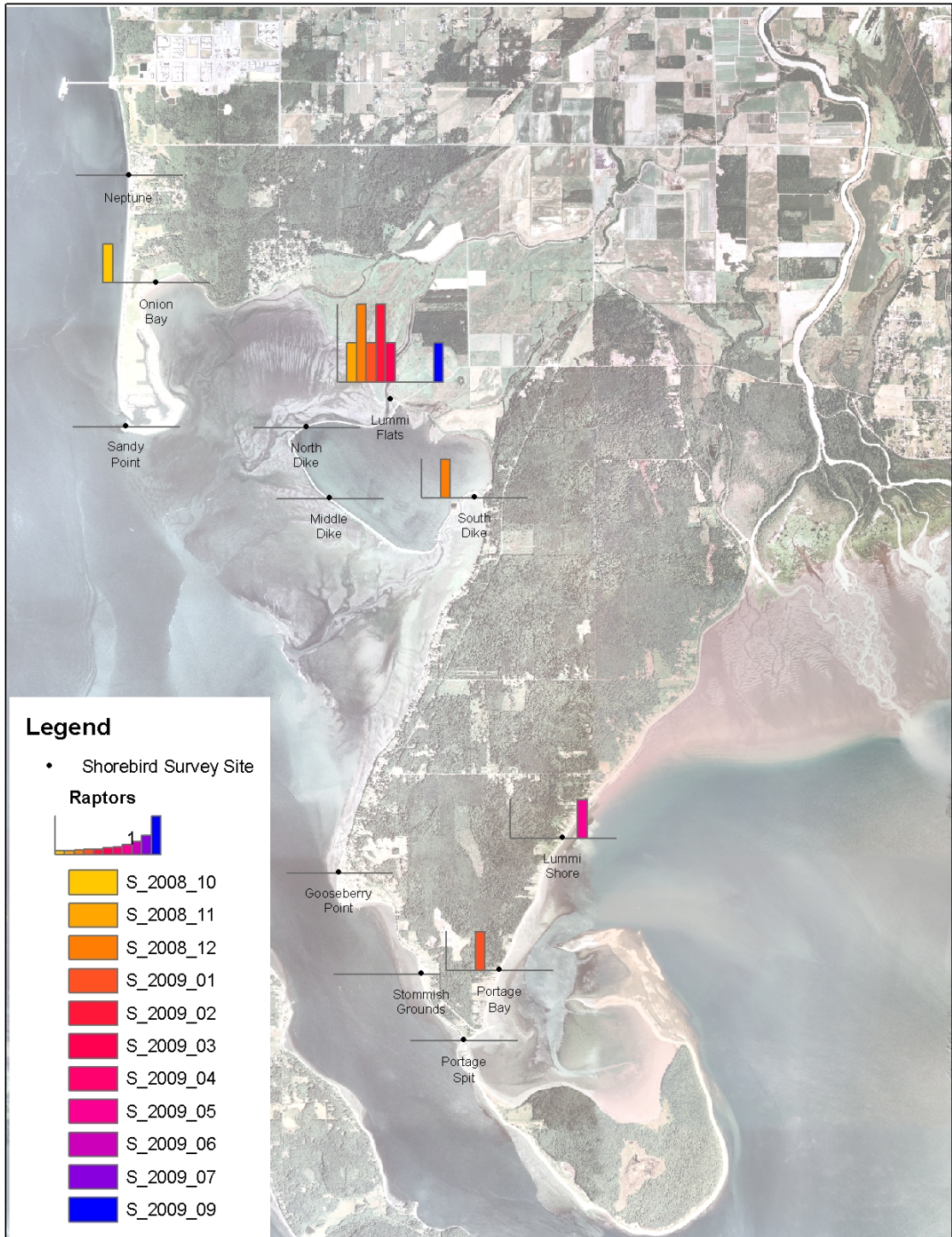
The LNR has also mapped the occurrence of active Bald Eagle nests, which are shown on Figure D.7 for reference (LNR 2008). In total, 28 active bald eagle nests have been documented within the boundaries of the Lummi Reservation.



**Figure D.7.** Temporal and Spatial Patterns in Bald Eagle Presence on Lummi Reservation Tidelands And Known Active Nesting Sites

### 3.4.2 Other Raptors (Order Falconiformes)

Figure D.8 shows the monthly counts of raptors, including northern harriers (*Circus cyaneus*), peregrine falcons (*Falco peregrinus*), and red-tailed hawks (*Buteo jamaicensis*) for each of the sites visited during the LIBI survey. The majority of raptor sightings were at Lummi Flats during winter months. In addition, there were some sightings at Onion Bay, Portage Bay, and along Lummi Shore Road scattered throughout the year.

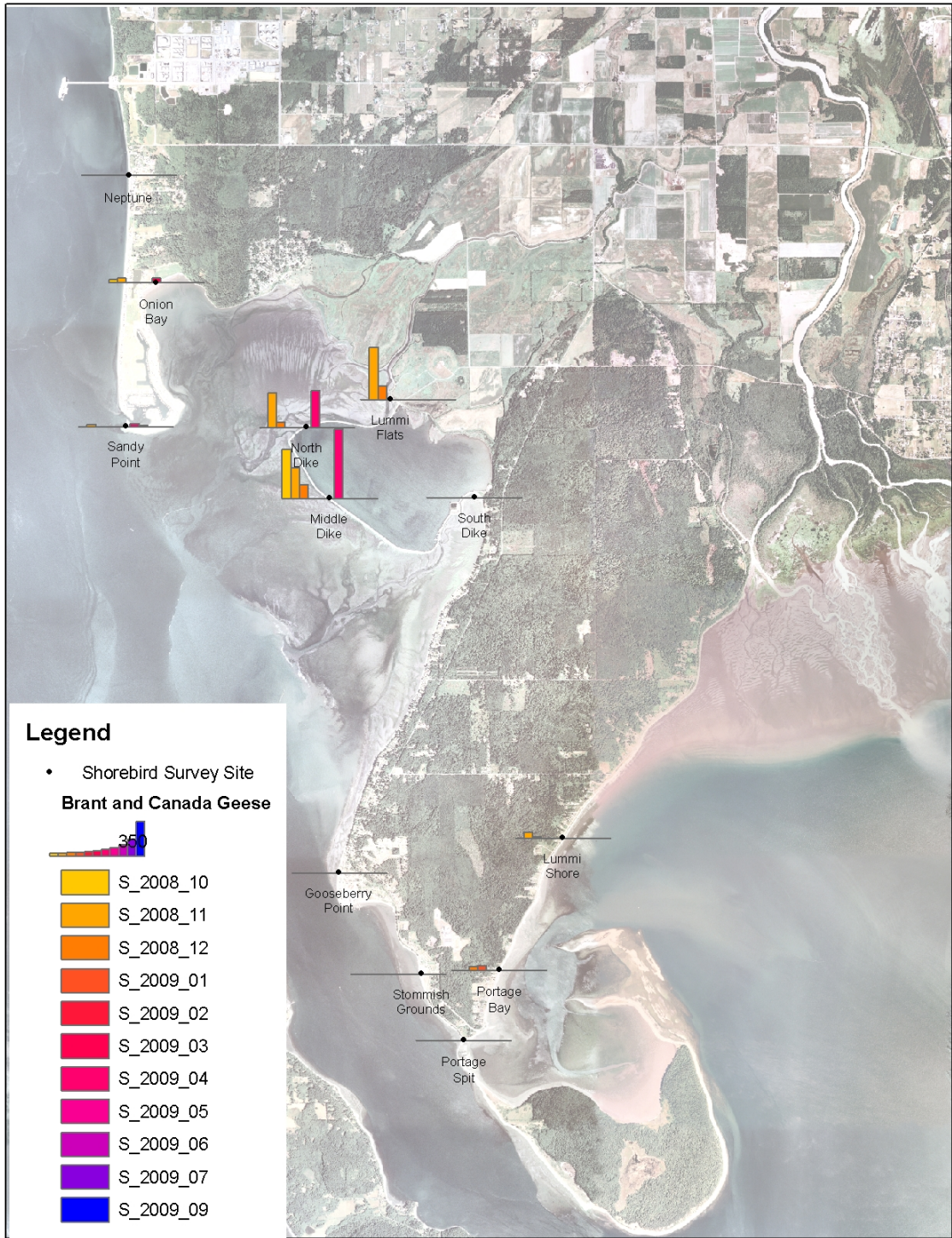


**Figure D.8** Temporal and Spatial Patterns of Raptors, Excluding Bald Eagles, on Reservation Tidelands

### 3.4.3 Geese (Subfamily Anserinae)

Figure D.9 shows the monthly counts for geese for each of the sites visited in the LIBI survey. Brant (*Branta bernicla*) and Canadian geese (*Branta canadensis*) were most abundant in Lummi Bay during the fall and winter months. They were also consistently present in low numbers during the fall and winter months at Onion Bay, Sandy Point, and Portage Bay.

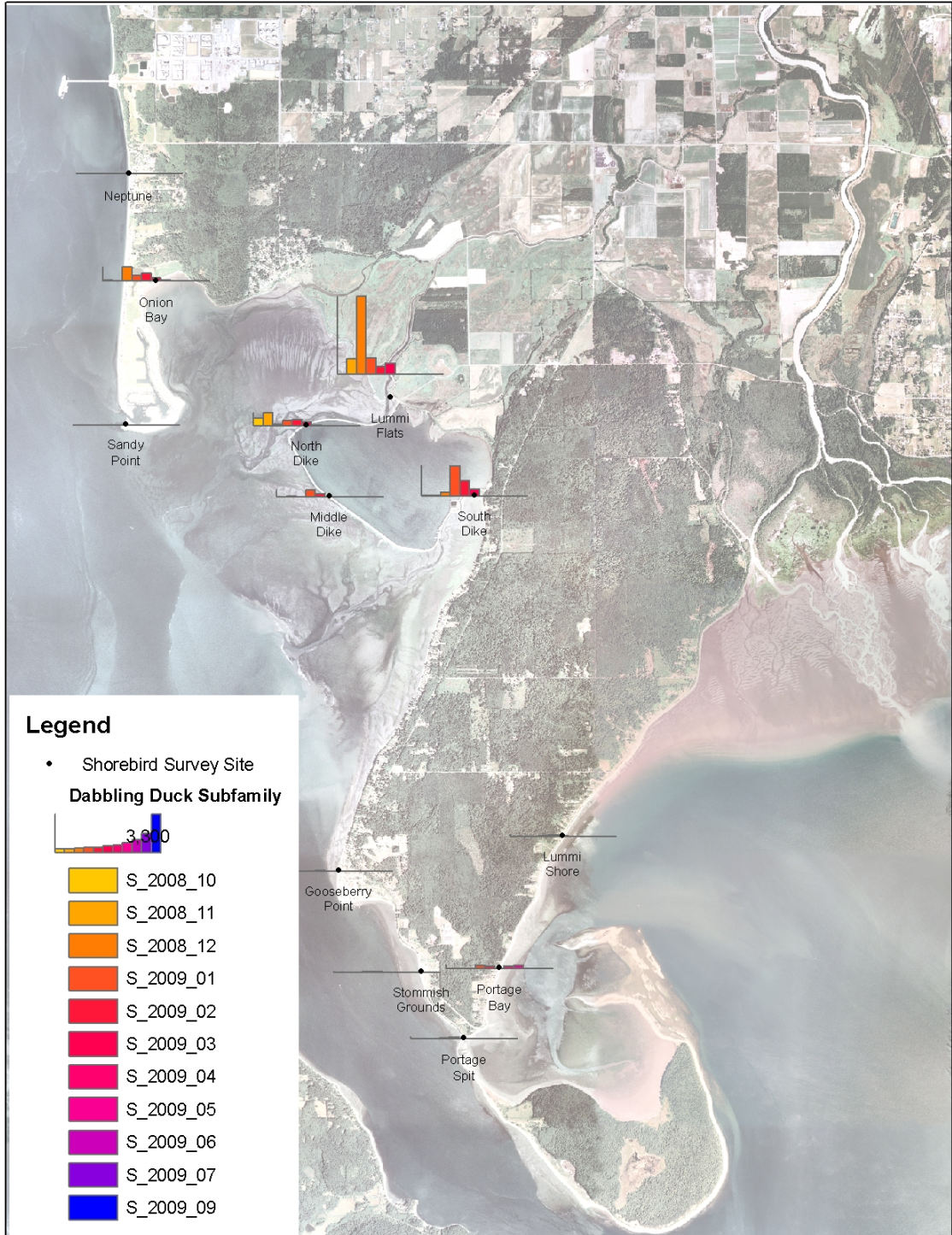




**Figure D.9** Temporal and Spatial Patterns of Combined Brant and Canada Geese on Reservation Tidelands

#### 3.4.4 Dabbling Ducks (Subfamily Anatinae)

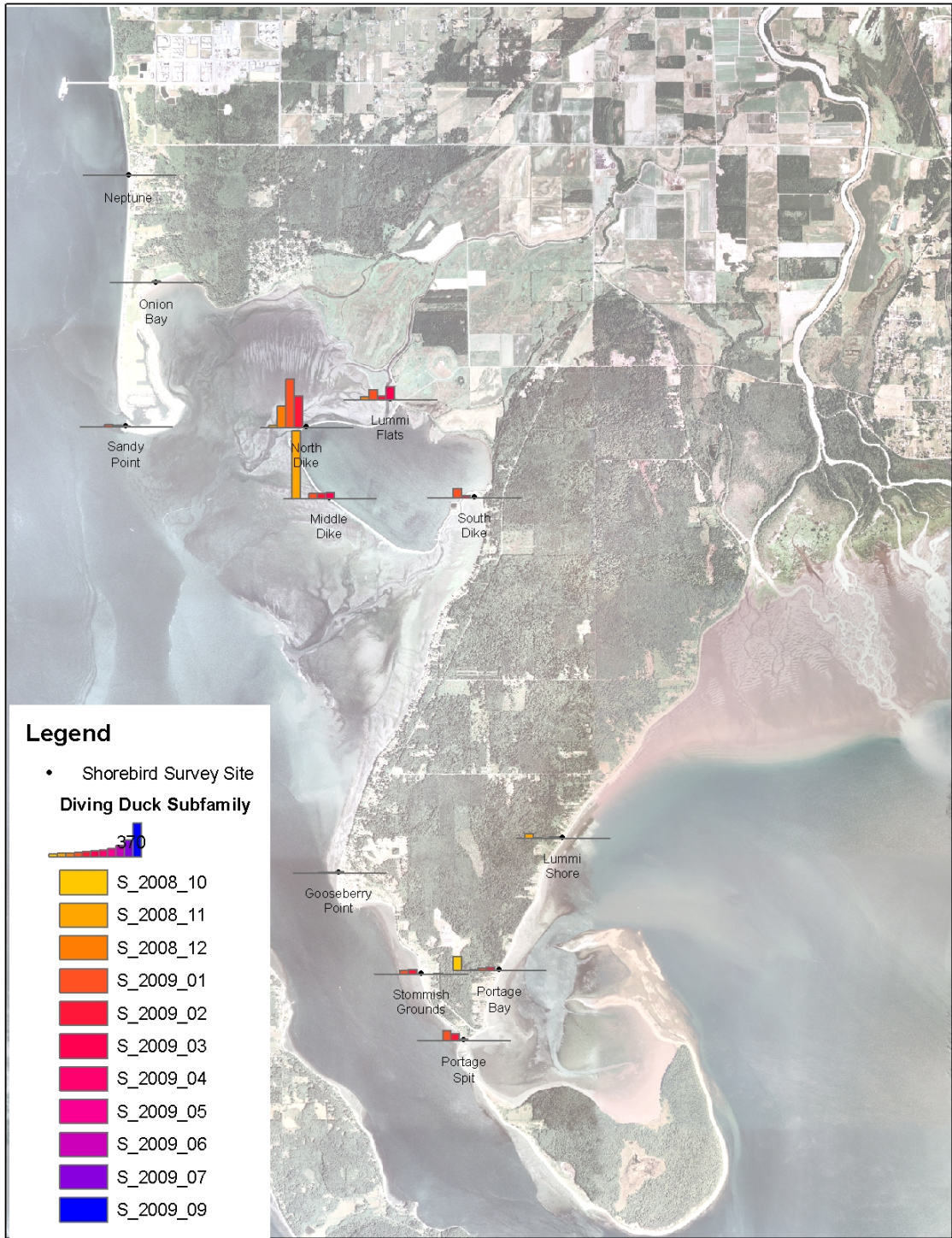
Figure D.10 shows the monthly counts of dabbling ducks at each of the sites visited during the LIBI survey. There were 6 species of dabbling ducks observed on Reservation tidelands: the mallard (*Anas platyrhynchos*), the northern pintail (*Anas acuta*), the american widgeon (*Anas americana*), the green-wing teal (*Anas americana*), the Eurasian widgeon (*Anas penelope*), and the gadwall (*Anas strepera*). Dabbling ducks are encountered from fall through spring on the Reservation. The majority of sightings were in Lummi Bay with a few at Onion Bay. The largest numbers of dabbling ducks counted were at Lummi Flats. Only a few dabbling ducks were counted at Gooseberry Point, and the Stommish Grounds.



**Figure D.10** Temporal and Spatial Patterns of Dabbling Ducks on Reservation Tidelands

### 3.4.5 Diving Ducks (Subfamily Aythyinae)

Figure D.11 shows the monthly counts for diving ducks at each site visited during the LIBI survey. Only 2 species of diving ducks were observed on Reservation tidelands: the greater scaup (*Aythya marila*) and the Longtailed duck (*Clangula hyemalis*). Diving ducks were seen at most sites across the Reservation. Diving ducks were most prevalent in Lummi Bay during the winter months. Diving ducks were also encountered at Gooseberry Point, Stommish Grounds, Portage Bay, and Lummi Shore Road throughout the winter and early spring.

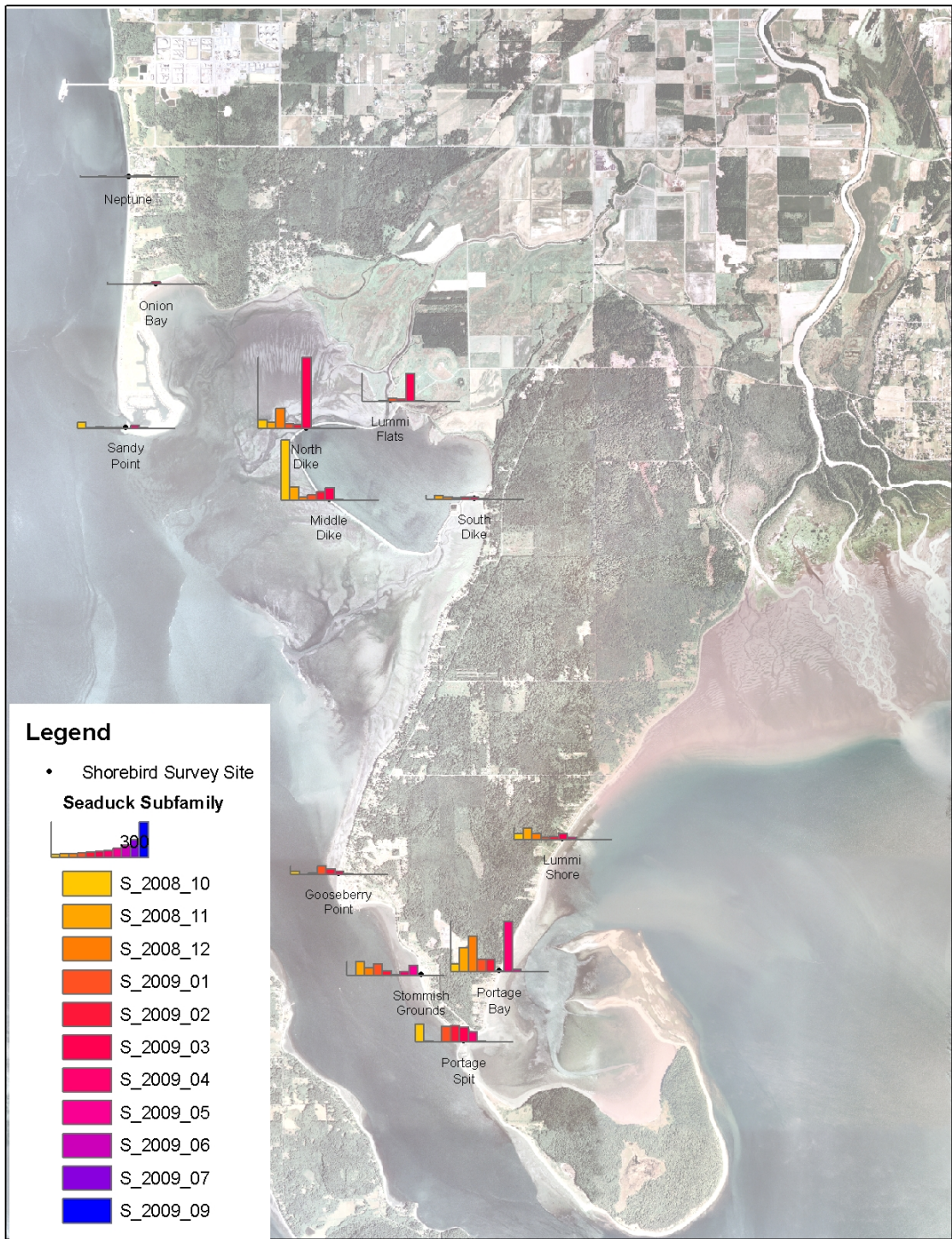


**Figure D.11** Temporal and Spatial Patterns of Diving Duck Abundance on Reservation Tidelands

### 3.4.6 Seaducks (Subfamily Merginae)

Figure D.12 shows monthly counts of seaducks at each site visited during the LIBI survey. During the survey, 10 species of seaducks were observed on the Reservation tidelands: the white-winged scoter (*Melanitta fusca*), the black scoter (*Melanitta nigra*), the surf scoter (*Melanitta perspicillata*), the bufflehead (*Bucephala albeola*), common goldeneye (*Bucephala clangula*), Barrow's goldeneye (*Bucephala islandica*), hooded merganser (*Lophodytes cucullatus*), common merganser (*Mergus merganser*), the red-breasted merganser (*Mergus serrator*), and the harlequin duck (*Histrionicus histrionicus*). Seaducks were encountered at all sites but were least abundant at Neptune Beach, Onion Bay, and the South Dike sites.

Seaducks were generally encountered from October through May on the Reservation tidelands. Scoters were consistently seen in large numbers in Lummi Bay, Hale Passage, and Portage Bay from October through May.

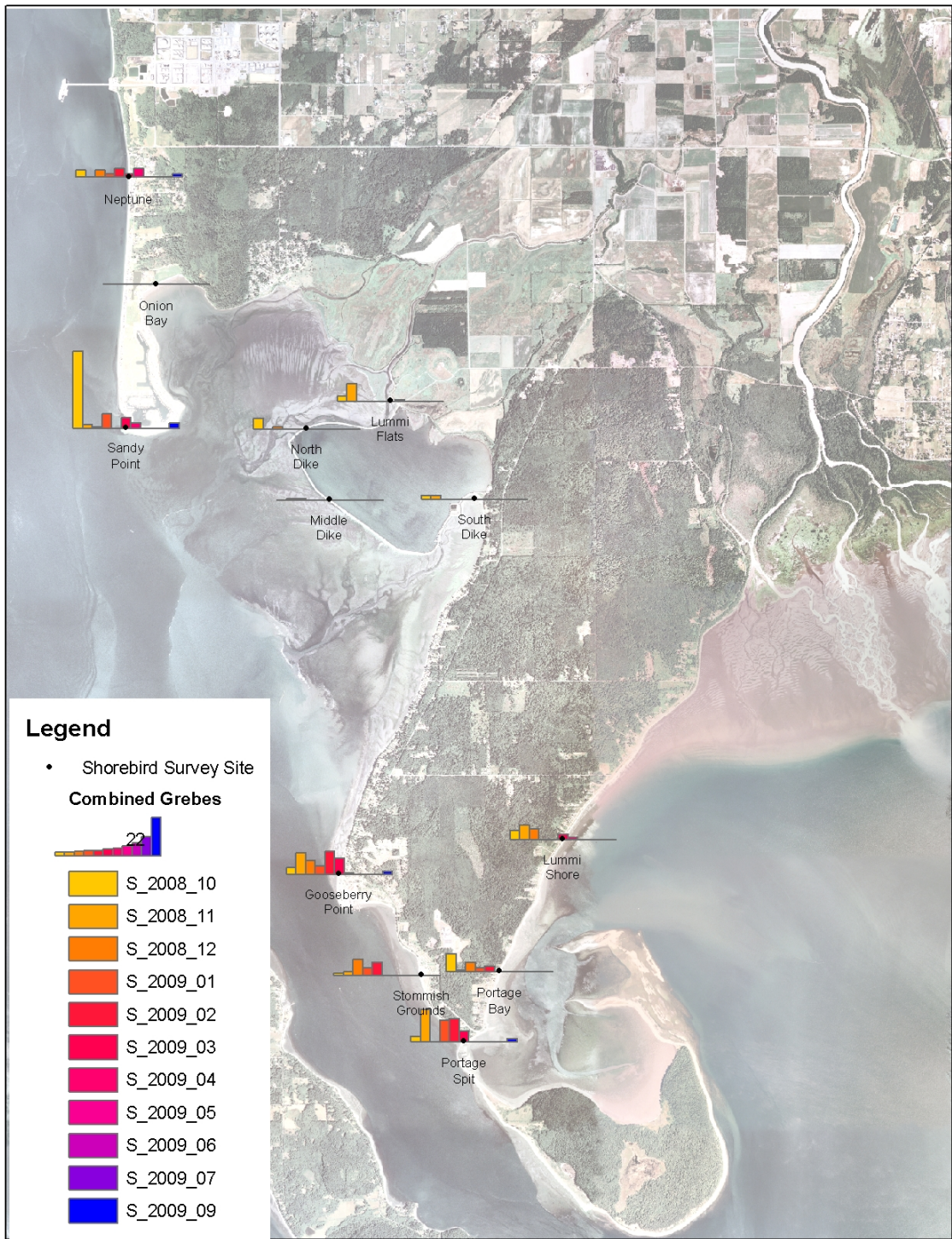


**Figure D.12** Temporal and Spatial Patterns of Seaduck Abundance on Reservation Tidelands

### 3.4.7 Grebes (Family Podicipedidae)

Three species of grebe were encountered during the LIBI survey: the horned grebe (*Podiceps auritus*), red-necked Grebe (*Podiceps grisegena*), and the western grebe (*Aechmophorus occidentalis*). Figure D.13 shows the monthly counts of all grebe species at each site visited during the LIBI survey. Grebes were encountered frequently and consistently along the Hale Passage and Portage Bay areas and the Neptune Beach and Sandy Point areas from late fall to early spring. Low numbers of grebes were encountered at sites in Lummi Bay during the fall.



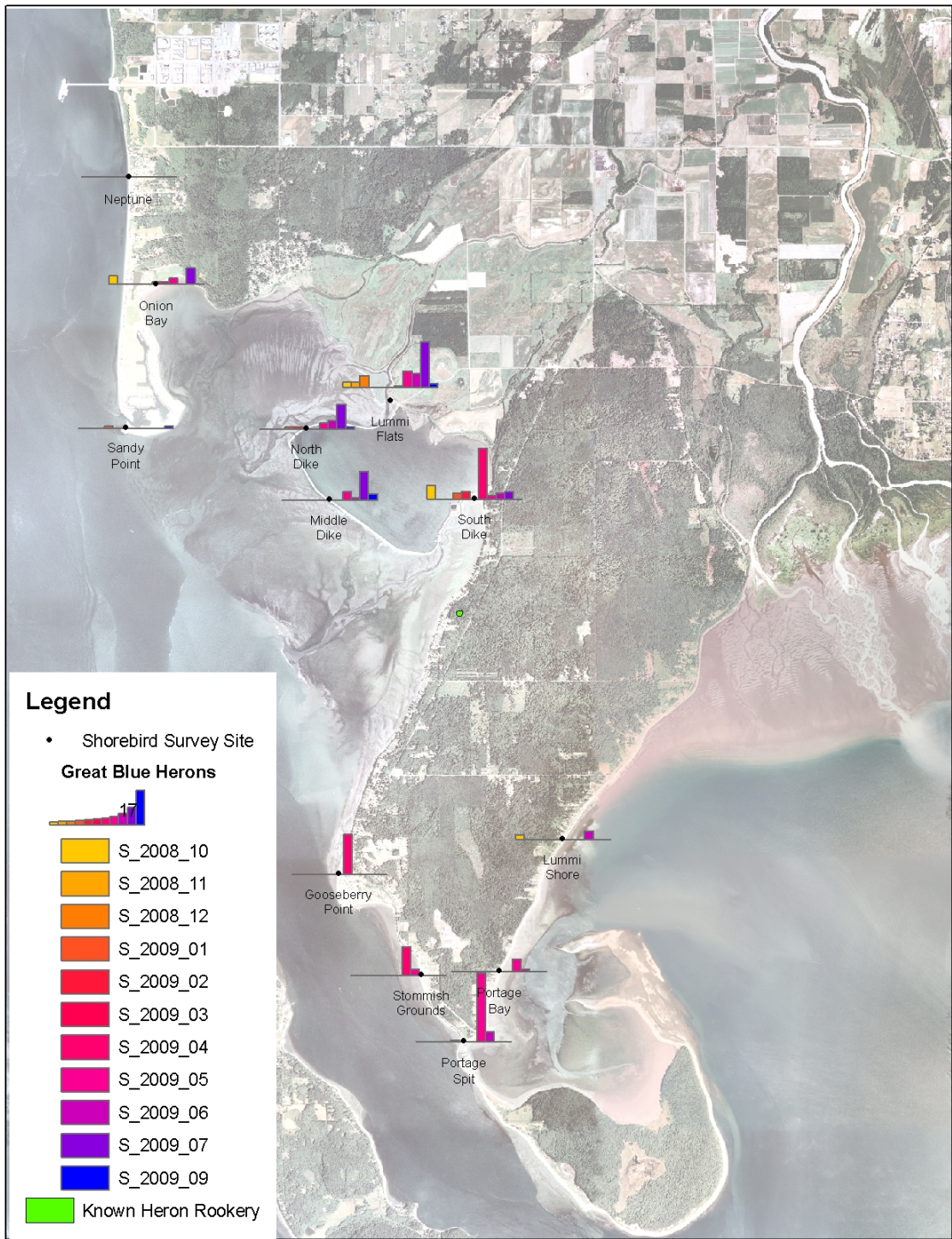


**Figure D.13** Temporal and Spatial Patterns of Grebe Abundance on Reservation Tidelands

### 3.4.8 Great Blue Herons (*Ardea herodias*)

Great blue herons (*Ardea herodias*) can be seen year round and in large numbers in the vicinity of the tidelands. Figure D.14 shows monthly counts of great blue herons at each site visited during the LIBI survey. Great blue herons were encountered at all sites except Neptune Beach. They favor Lummi Bay year round, and congregate in large numbers around Portage Bay in the spring and summer months.

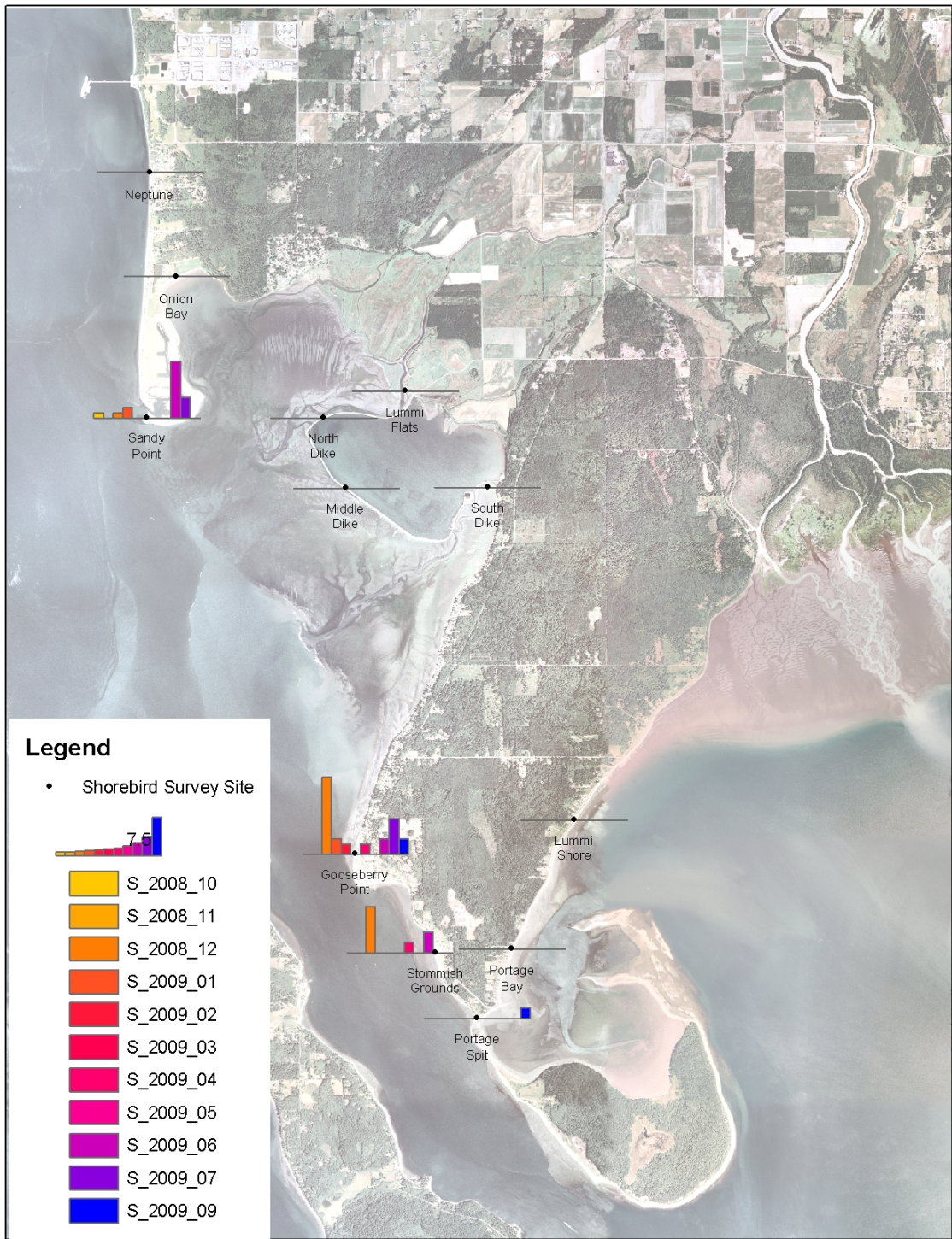
There is a widely known great blue heron rookery located on the Reservation near Robertson Road. In 2009, approximately 160 nests were counted in this rookery (LNR, Unpublished Data). There may also be additional rookeries that have not yet been documented elsewhere on the Reservation.



**Figure D.14** Temporal and Spatial patterns of Great Blue Heron Abundance on Reservation Tidelands and Location of Heron Rookery

### 3.4.9 Alcids (Family Alcidae)

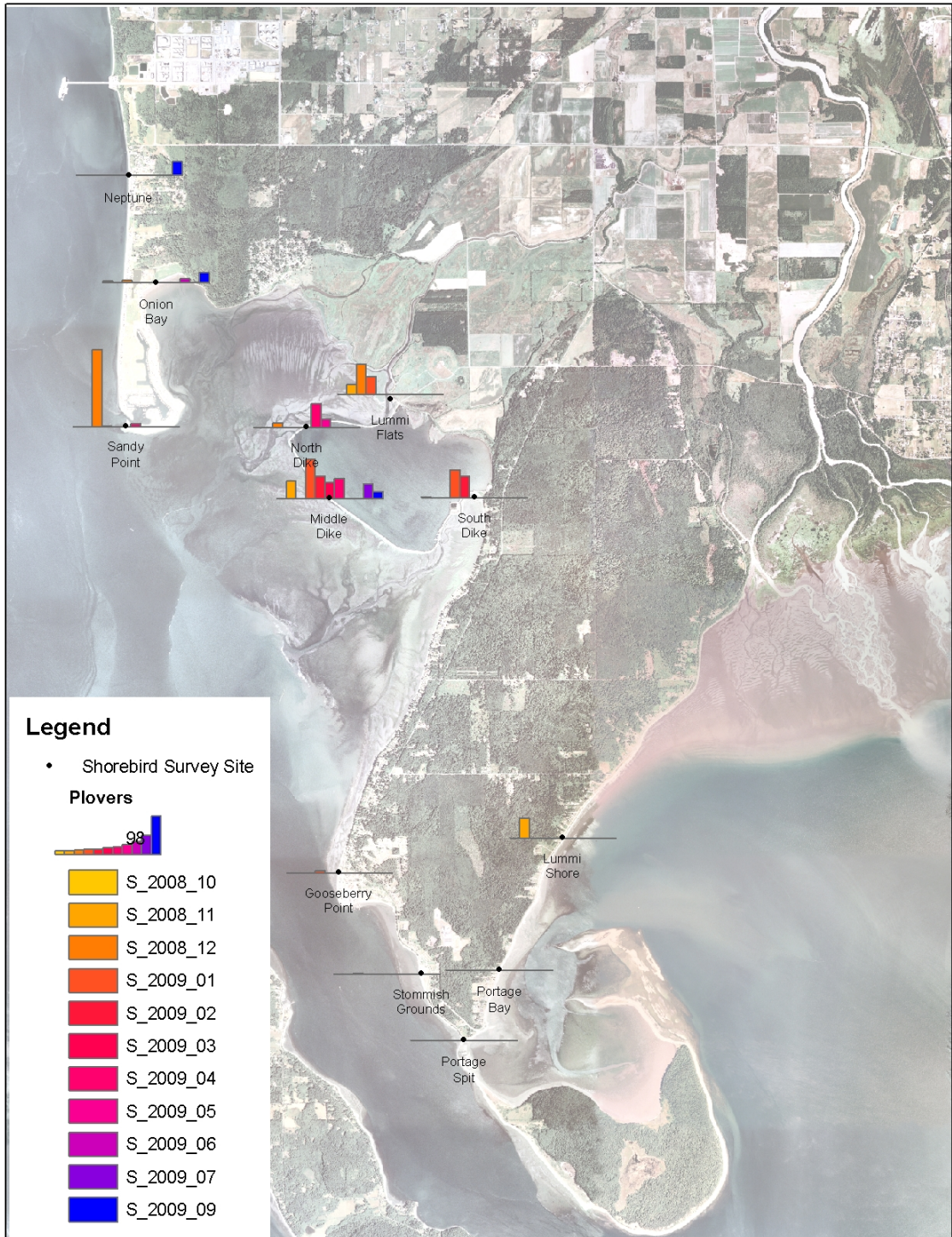
Alcids are an oceanic family of birds that use their wings to “fly” underwater to catch prey (Sibley 2003). Two alcid species were observed in the study: marbled murrelet (*Brachyramphus marmoratus*) and pigeon guillemot (*Cepphus columba*). Figure D.15 shows monthly counts of alcids. Alcids were encountered at Sandy Point, Gooseberry Point, Stommish Grounds, and Portage Spit and were seen year round.



**Figure D.15** Temporal and Spatial Patterns of Alcid Abundance on Reservation Tidelands

#### 3.4.10 Plovers (Family Scolopacidae)

Figure D.16 shows monthly counts of plovers at each site visited during the LIBI survey. Plovers were seen primarily at the northern sites on the Reservation. Plovers were encountered year round from Neptune Beach to South Dike, and along Lummi Shore Road in the winter. Dunlin (*Calidris alpina*), black turnstone (*Arenaria melanocephala*), and western sandpiper (*Calidris mauri*) are generally wintering residents in the Salish Sea area (Sibley 2003). Killdeer (*Charadrius vociferus*) are year round residents and are known to nest near Sandy Point.

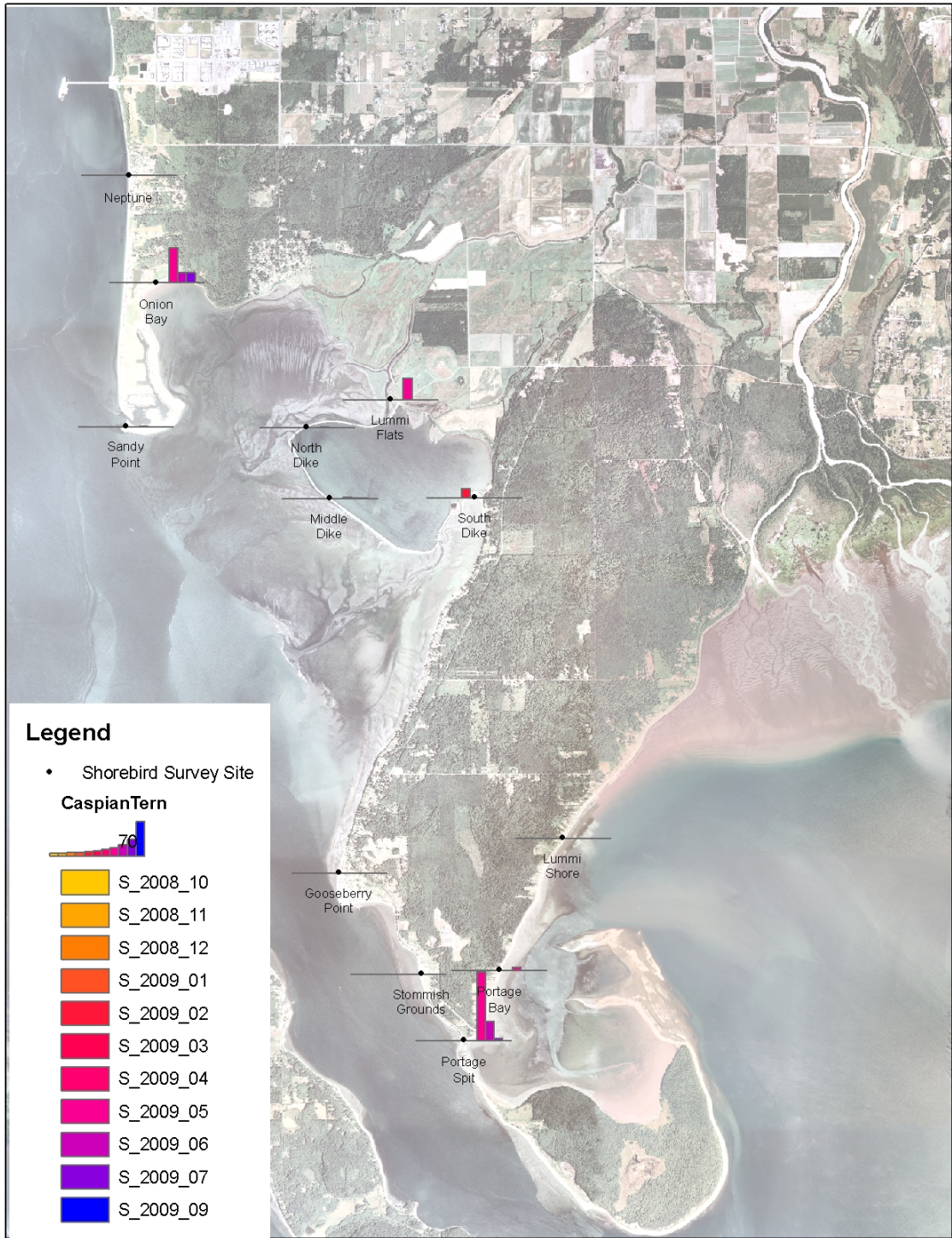


**Figure D.16** Temporal and Spatial Patterns of Plover Abundance Across Reservation Tidelands

### 3.4.11 Caspian Terns (*Sterna caspia*)

Figure D.17 shows monthly counts of Caspian terns (*Sterna caspia*). Caspian terns are one of the few sea birds that migrate to the Salish Sea to breed in the summer. They were encountered at Onion Bay, Lummi Flats, South Dike, Portage Spit, and Portage Bay. The largest numbers of Caspian terns were counted at Onion Bay and Portage Spit.

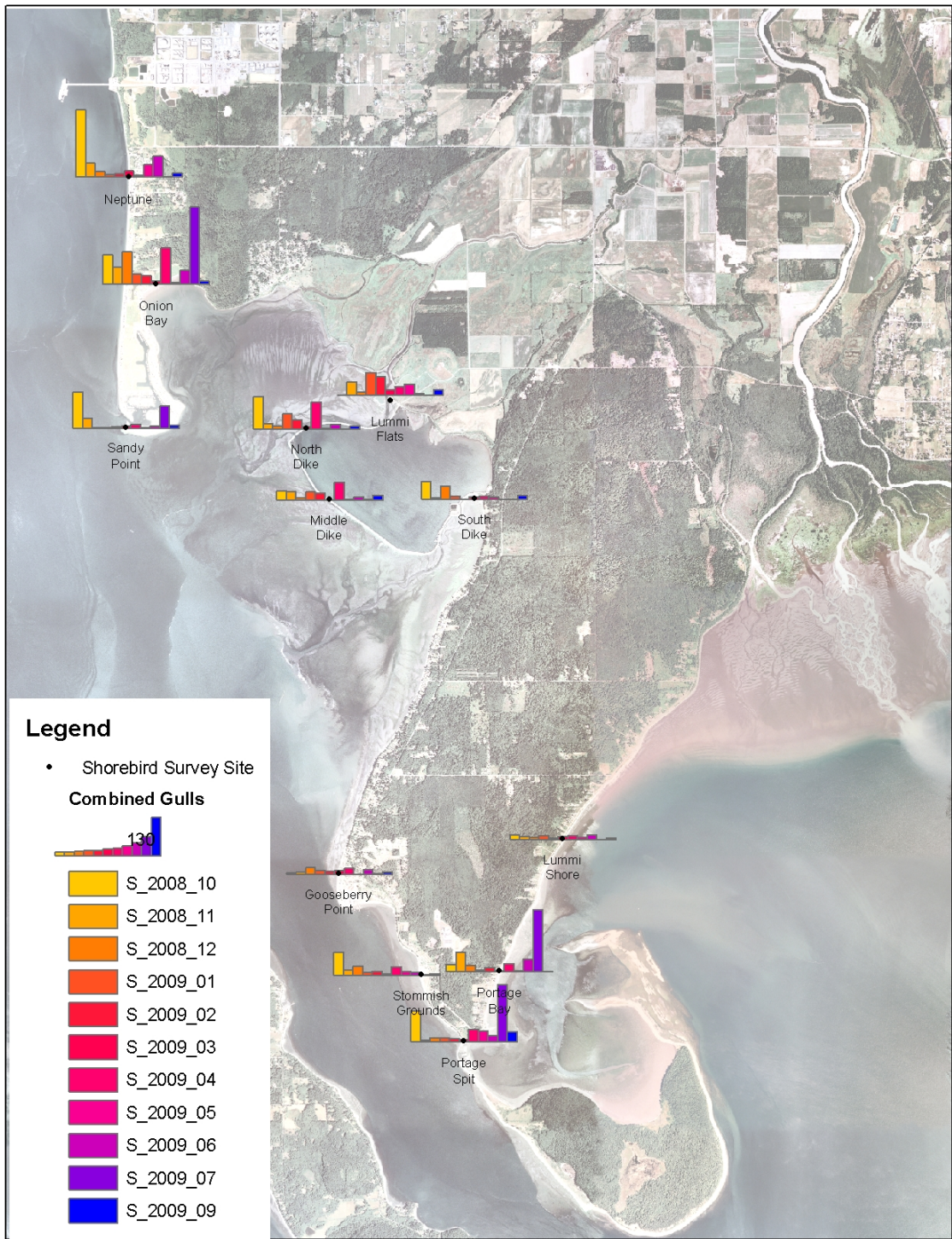




**Figure D.17** Temporal and Spatial Patterns of Caspian Tern Abundance Across Reservation Tidelands

### 3.4.12 Gulls (Family Laridae)

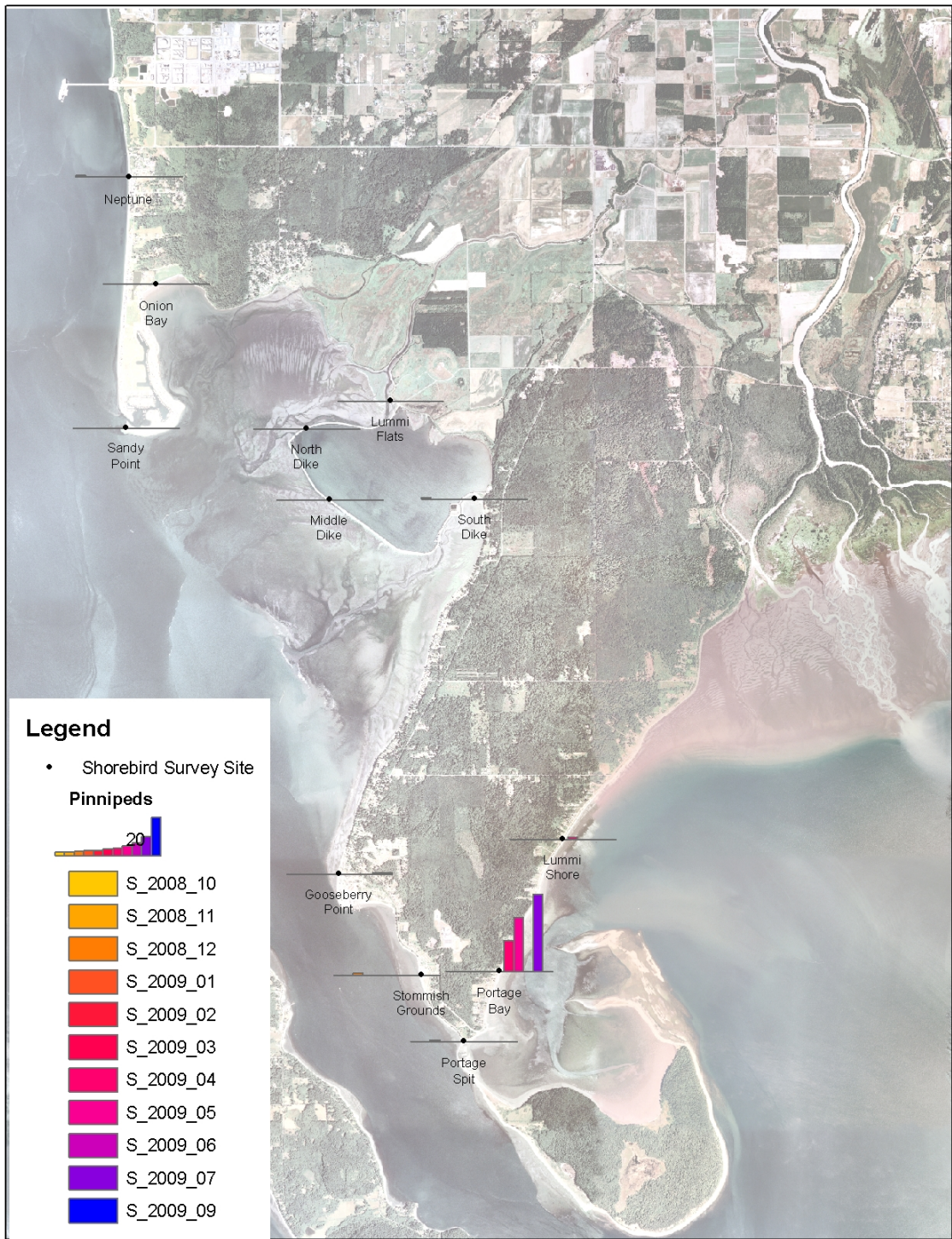
Figure D.18 shows monthly counts of combined gull species at each site visited during the LIBI survey. Six species of gull were observed during the survey: the glaucous-winged gull (*Larus glaucescens*), Bonaparte's gull (*Larus philadelphia*), California gull (*Larus californicus*), herring gull (*Larus argentatus*), mew gull (*Larus canus*), and the ring-billed gull (*Larus delawarensis*). Most gull species can be seen year round across the Reservation. Although some species and some individual gulls may migrate seasonally, it is not uncommon to see wintering species also in summer months. Gulls were counted in high numbers at Neptune Beach, Onion Bay, and Portage Bay.



**Figure D.18** Temporal and Spatial Patterns of Gull Abundance Across Reservation Tidelands

### 3.4.13 Pinnipeds (Superfamily Pinnipedia)

Figure D.19 shows the monthly number of pinnipeds encountered during the monthly LIBI shorebird census. The species of pinnipeds encountered on the Reservation were the Harbor seal (*Phoca vitulina*) and the California sea lion (*Zalophus californianus*). Pinnipeds were most frequently encountered at Portage Bay in the spring and summer but were seen at least once at Neptune Beach, South Dike, Gooseberry Point, Stommish Grounds, Portage Spit, and Lummi Shore Road throughout the year.



**Figure D.19** Temporal and Spatial Patterns of Pinniped Abundance Across Reservation Tidelands

## 4.0 Discussion

Sea lions and harbor seals were most commonly seen on Brant Island where they regularly haul out from May to September. Occasional sightings of these marine mammals also occurred in the marine waters around the Reservation. These animals may be attracted to the area by the returning runs of salmon to the Nooksack River during the spring and summer months.

Shorebirds were generally more diverse and abundant in the winter than in the summer, and more abundant in sheltered areas such as Lummi Bay, Portage Bay, and Hale Passage. The overall diversity of birds was highest at Lummi Bay, Hale Passage, and Neptune Beach, and lowest at Portage Bay and Bellingham Bay.

The seasonal distribution of shorebirds on the Reservation is typical for this region's bird migratory patterns with large numbers and multiple species of ducks and geese overwintering and foraging in the more protected areas of the Reservation tidelands, then departing again in the spring.

There are also some species that live on or near the Reservation year round (e.g., great blue herons [*Ardea herodias*] and glaucous-winged gulls [*Larus glaucescens*]). Although there are fewer shorebirds on the Reservation during the summer months, they include important seasonal visitors like the Caspian tern.

The spatial distribution of shorebirds on the Reservation is dependent on the habitat requirements of each species. Both diving and dabbling ducks tend to prefer Lummi Bay and Portage Bay, where they find the vegetation and small invertebrates that are their primary food sources. Scoters were encountered in Lummi Bay and around Portage Spit, where they feed on shellfish and mollusks. Alcids were found to prefer Hale Passage; and these species feed almost exclusively on small fish and shrimp-like crustaceans (Johnsgard 1987). Bald eagles (*Haliaeetus leucocephalus*) were counted at most areas of the Reservation, except Neptune Beach where the close proximity of houses to the relatively narrow beach limits opportunities for bald eagles to remain undisturbed. Other raptors were primarily located near the edge of the saltmarsh in northern Lummi Bay, where small mammals, such as mice and rabbits are likely to be available in the adjacent fields. Gulls, being more opportunistic feeders, were found at all sites across the Reservation tidelands.

Absolute abundance comparison between the LIBI and the Western Washington University (WWU) and North Cascades Audubon Society (NCAS) survey results is problematic because of methodological differences and differing survey objectives. The WWU surveys are designed to compare yearly trends in wintertime abundance for a particular list of marine bird populations, and included birds from off-Reservation areas that were not included in the LIBI. This work has shown significant declines in 26% of the most common overwintering Salish Sea marine bird species within the last 30-40 years (Bower 2009). By contrast, the LIBI study was designed to count all bird species that use the Reservation tidelands during the entire year. As a result, only the diversity of wintering bird species found across the Reservation tidelands can be directly compared to the WWU results. Bird species that were observed in the LIBI study but were not present in the WWU study include long-eared owls (*Asio otus*) and snow buntings

(*Plectrophenax nivalis*). The only bird species documented by the WWU survey that was not seen in the LIBI study is the canvasback duck (*Aythya valisineria*).

The LIBI bird survey provides a snapshot of tideland utilization by a wide array of bird species; however, some important areas were not included in this survey. Brant Island, Portage Island, and the central portion of the Nooksack River Delta are more difficult to access than the areas that were surveyed. These areas were excluded because their inclusion would have required a significant additional investment in time and resources that could not be justified given the prioritization outlined in the LIBI final work plan. Portage Island and Brant Flats are known to provide valuable habitat for a wide diversity of shorebird species. Accordingly, any future bird survey efforts should also attempt to include these areas. The use of a boat as a platform for conducting bird surveys may be critical to expand the scope of the survey to include birds that inhabit hard-to-reach beaches and deeper waters that are further from shore.

## 5.0 References

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